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Election Day and the Engineer

WITH Election Day close at hand the engineer must assume a certain responsibility in placing in offices which require technical knowledge on the part of the incumbent the men best qualified to administer the work. It is unfortunate that in many cities the practice of electing such officials as city engineers still obtains. These men should not be chosen by popular vote but should be appointed, with due regard to their fitness to perform the duties required of them. The average citizen with a ballot before him generally looks blankly at the names of candidates for engineering offices and then votes a straight ticket. He is in no position to make an intelligent selection. Yet his verdict decides the case of the city engineer. It is the clear duty of local engineering societies to investigate the qualifications of candidates for technical posts and indorse only those men who merit election. This can not be construed as electioneering. It is, on the contrary, a public service which can be easily rendered. It has as a precedent the action of bar associations in indorsing the candidates for elective judicial positions.

Speed Capitalized

IF SURFACE indications have been correctly interpreted developments in this country, due to the war in Europe, are opening up real opportunities to American concerns equipped to do work and supply materials quickly. Old plants are being remodeled and new ones built to handle the influx of war orders. All of this expansion, naturally, is rush work and it is the speed element which is the determining factor in the award of new contracts, provided, of course, construction or materials of satisfactory quality can be produced under conditions of forced draft. A number of concerns have been shrewd enough to capitalize this demand for speed by a campaign of publicity emphasizing in what ways their products can be utilized to cut down on the usual time required for construction work. The fact that new plants are needed, and needed quickly, is well illustrated by the case of a motor truck company which is assembling its machines under canvas circus tents. The munitions factories have, of course, been busy for months past putting up new buildings to increase their output, but it must not be inferred that new construction is being undertaken exclusively by concerns supplying ordnance, shells and other materials needed by the warring nations. A straw in the wind, indicating an awakening in other industries in the United States, is furnished by the statement, commented on editorially in this journal last week, in which the Government announced a policy of protecting, after peace shall have been declared, capital invested in American industries established to supply products, formerly foreign made, which the war has curtailed. The growth of a dye industry in the United States, with the consequent necessity for new building construction on a large scale, is only one of the promising opportunities which the future holds for engineer, contractor and material manufacturer. As matters now stand, however, it is the rapid worker who is getting the cream of the construction and engineering equipment business. Concerns in all lines which are affected by the industrial expansion will do well to make the most of their facilities for speedy construction.

Barge Canal Bond Issue

TUESDAY the voters of New York State will decide the fate of the proposed bond issue of $27,000,000 to complete the Barge Canal. Whatever one's views may be as to the wisdom of the original undertaking, the efficiency or honesty of the administration of the funds already provided, the benefit to come to the State from the finished canal, the question to be settled now is whether the State is willing to leave, longer than necessary, its great ditch unfinished and practically unserviceable. It is too late to decide not to build the canal. That might have been done ten years ago, but now the State has put more than $100,000,000 into the work. Engineers know that whether or not the money has gone as far as it might have there is much to show for it, and that legitimate additions to the original project and unforeseen contingencies have had much to do with the exceeding of the original estimate. The proposed bond issue, therefore, should be ratified and the canal should be finished as soon as possible and given a chance to justify itself.

Keep the Road Dry

WITH the advent of fall it is in order to sound the trite warning concerning the damage to roads by frost action unless adequate precautions are taken to insure thorough drainage. As the Office of Public Roads of the Department of Agriculture has pointed out in a timely bulletin, it is water, not cold, which is responsible for the deterioration of highways in winter. The familiar "heaving" of a road is the direct result of the pushing apart of its component materials by the expansion which follows the conversion into ice of the water retained in its interstices. The remedy is obvious—Keep the road dry. Now is the time to adopt preventive measures. Keep the ditches and drains open. Remove all accumulations of weeds and grass which retain moisture and obstruct drainage. Use the drag frequently on earth and gravel roads. Fill in and consolidate all raveled spots in macadam surfaces. Winter destruction of roads really begins in the fall. If this destruction is to be minimized road engineers should begin now to take the simple precautions which will safeguard the traffic routes over which they have supervision.

Standardizing Concrete Roads

ENGINEERS are fast adopting the common-sense view that the cheapest structure is that which costs least per unit of time that it is in service. The automobile has made the soft-surface road more expensive to maintain than hard roads of several times the soft-surface road's first cost. Concrete is gaining favor as a road building material because its first cost is being lowered and the quality of the concrete improved by efficient construction methods. Undesirable features in the finished road are being eliminated by increased engineering experience and skill in dealing with the design of the road slabs and in providing proper specifications. With the idea of furthering knowledge along both of these lines the construction of the experimental road, described on page 530 of this issue, has been undertaken by the engineers of the Pennsylvania State Highway Department with the co-operation of a number of cement manufacturers in the surrounding territory. While these men are not building the first or even the first good concrete road, they are, nevertheless, pioneers in the sense that they are crystallizing the best developments of concrete road practice in a way that will make it possible for any engineer to design and any contractor to build a good concrete road with economy. This is a service, performed years ago in the case of steel structures and only recently in the case of reinforced-concrete buildings, which should be welcomed by all highway engineers.

English for Engineering Students

IT CAN safely be predicted that the course in English for seniors, introduced for the first time this year in the engineering department at Princeton University, will be no uncertain factor in increasing the usefulness of that institution's graduates when they buckle down to real work after receiving their degrees. Engineers, as a class, are notably deficient in expressing their ideas on paper, and this has been the natural result of a short-sighted policy in technical schools where the aim has been merely to cram the students as full of "practical engineering" as is possible in the four-year period of instruction. It should be remembered, however, that the man who can write well is not necessarily a good engineer, but the man who combines the abilities of good writing and good engineering possesses an asset of incalculable value. Men with these qualifications, reinforced with the necessary personal characteristics, reach the positions of high executive authority, while their less talented comrades must be content with the subordinate posts. To attain facility in writing requires hard work and much practice except in the case of the rare genius with an inborn aptitude for it. Writing is not a trick that can be learned over night, but it is well worth the effort expended on it. It is high time for all engineering colleges which have neglected their duty in insisting upon instruction in English to organize courses such as the one which has been inaugurated at Princeton.

City Guide Posts

THERE is no good excuse nowadays for not marking the names of city streets at intersections, and yet many cities are sadly deficient in this respect. Perhaps some city engineers consider it a matter of minor importance, but, in reality, it is a very essential feature in making a good impression on the stranger. Since it is the stranger that uses the street markings most, complaint about lack of attention to this matter unfortunately often fails to strike home with effect, and some communities boasting many municipal improvements overlook this detail, and the stranger, particularly the newcomer, is inconvenienced and vexed while he is getting his first impression of the city. City engineers the country over have developed schemes for posting the names of streets until there are probably almost as many methods as there are cities.

Schemes that can be applied in one city may not be at all suitable in another, but it would be well if every city engineer made it a point to study this question as he would any other engineering problem and not continue to renew old signs with duplicates simply because that particular style has been used before. A sidewalk name plate that has recently been received with much favor in western cities consists of an angle iron set horizontally in the curb, one face flush with the sidewalk surface and the other flush with the vertical face of the curb. The iron is painted black and on the vertical face the name of the street appears in raised letters painted white to make them stand out. This type is never hidden underfoot and lasts indefinitely.

Where lighting standards are available for elevating the signs their usefulness can be greatly increased, especially for residents if, under the street name, "600 Block" or a similar designation is used to locate the street numbers. Street names etched into electrolier globes have the advantage of being readily legible day or night, but renewing the breakages is costly. A commendable spirit was recently shown by the city engineer in a small western town who had available no funds for etched globes, but realizing the desirability of marking the streets had his draftsman cut stencils from cardboard and with these painted the street names on the electrolier globes. This simply illustrates the point that no matter what the conditions or lack of funds, there can be found some simple but effective means of marking all the streets and until this has been suitably done no city engineer should be content to let the matter rest.

Chicago Public Utility Galleries Become a Reality

STREET opening in the heart of our large cities is at best a most annoying and expensive operation, to say nothing of the irreparable injury done to pavements. New York had a chance, when its streets were first opened for subway construction, to build public utility galleries and William Barclay Parsons favored their construction, but the utility interests were unwilling to give up fancied or real rights enjoyed by having their conduits buried in common earth.

New York has a short stretch of gallery which has not been occupied. In Chicago there is now being constructed three and one-half blocks of model gallery in connection with the new Union Station. The Union Station Company is required to re-arrange at its own expense pipes and wires in the streets to be disturbed by its construction activities. According to agreement the company must maintain the pavements for many years to come, so it was not hard for the Commission on Downtown Municipal Improvements, the commissioner of public works, the city engineer and city council to arrange with the company to build the model gallery. Strange to say, the utility companies were not much interested, but some of them have been persuaded to enter the project. Many objections were raised. Gas explosions, broken water mains, and fuse blowouts were inimical to good service, the telephone and telegraph company contended. Decreasing the plant investment was also given as an excuse for staying out, and this is probably a perfectly valid one; for a corporation, which is a mere tenant of a municipally owned gallery, would not be able to claim in its appraisal values expensive pavements built on top of them. There would no doubt be a chance for tampering with the various mains, but probably the chances are not greater than those offered by numerous manholes now in service. The advantage of being able to inspect the lines daily and make immediate repairs is a very real one in many instances. In German and French cities no gas mains are included, but in London the gas mains have never caused an accident.

As to the practicability from a financial standpoint, Alvord & Burdick reported last year that foreign experience indicates that utility galleries, as applied to streets where the investments are already made, are not financially practicable, but where new streets are opened such galleries are warranted. They pointed out further in this report, which was abstracted in the Engineering Record of Jan. 9, page 53, that many streets in Chicago will be torn up, thus affording a chance to install galleries. The utilities should realize that the costly nuisance of digging up paved streets will have to be abated.

Highway Traffic Regulations Should Be Standardized

IN THE latter part of the eighteenth century there were what were described in England as the "new users" of the roads—the stage coaches. Parliament at that time passed many acts dealing with the building and regulation of highways. The beginning of the twentieth century sees another new user of the roads—the motor vehicle—which, in turn, has given rise to numerous statutory provisions relating to highways and the control of traffic. The control of modern road traffic is a problem which must receive concerted and scientific study if it is to be solved. The many and various regulations in force to-day make impossible either compliance with the laws or adequate provision for the safety of the traveling public.

In many localities danger signs have been posted, some by public officials, some through the enterprise of automobile associations. There has been, however, no uniformity, as might be expected under such circumstances. In most cases it is necessary to stop or greatly slow down a vehicle if the warning on the sign is to be read. Thus the signs become practically useless.

The traffic rules for cities are many, while the signals of the traffic police often are as complicated as those of a freight brakeman making up a train. In some cities two whistles mean east and west traffic open; in other cities two whistles are for north and south traffic. In any event one is supposed to distinguish the whistle above the chug and rattle of a street full of traffic. Sharp curves and steep hills are danger places whose proximity is variously indicated. It remains to have uniform markings so that, in any locality, one may know the road by standard warning signs.

A device used on some of the trolley lines in Massachusetts might offer a suggestion for highways. The poles are painted white to a height of 5 or 6 ft. on tangents. On approaching a curve the white band is raised on succeeding poles until it extends 10 or 12 ft. high near the tangent point of the curve, the rise of the bands being more or less gradual according to the sharpness of the curve. Such a device needs but a glance to understand its message. Whether such an arrangement would work satisfactorily on highways where poles are along side is problematical. But who to-day is to answer such a question? There should be some department or some bureau which should have charge of such matters.

At present what is done when similar suggestions are made is for some county or perhaps State official to try them out, and, finding some one satisfactory, install the method with the result that one does one way and another a different way, both to accomplish the same purpose. But what of the road user who meets a dozen or more such devices in the course of a day's ride? How is he to know their significance?

The answer to the whole situation will be found as soon as some one is given the task of studying the situation and reporting on standard methods to be used under given conditions. Such a study could be logically undertaken by the U. S. Office of Public Roads, and it is to be hoped Congress will see the importance of such an undertaking and appropriate the comparatively small amount that would be necessary. Federal aid of this sort is both sane and practical.

Published Cost Data and the Contractor

COST data should not be published with the idea of benefiting the contracting business. They may be published for the benefit of engineers who are not in a position to obtain them directly, but persons seeking information on which to make estimates for bids should use any such published information with great caution. It must be borne in mind that while engineers' estimates should be, and are, most carefully made, the engineer does not lose money or have to go out of business because of slight mistakes in estimating doubtful factors. This possibility contractors must face, especially when competition is keen. An engineer's estimate should be as accurate as possible, but on a contractor's estimates depend his very business existence.

Cost data may be divided into three classes. First come those kept by public works engineers on operations conducted under the day-labor plan. This class of costs is frequently met with in print. Second, there are often published by engineers and others costs of work done under contract by another party. Last are the cost data kept by contractors for their own use and usually closely guarded.

The first class of costs is misleading in two ways to the intending bidder on similar work. A community is not a contractor. It does not have to make a profit out of doing a job by day labor in order to stay in business. If a public works engineer does with day labor for $47,000 what a contractor offered to undertake for $50,000 people look only at the fact that he has saved the city $3,000. In all probability, however, the contractor who bid $50,000 would have done all the work charged to the job by the city for $40,000, the rest of this bid covering overhead expense and his profit. For this reason the city engineer does not have to be as efficient a constructor as the contractor to make a favorable showing against contract prices. Such costs are apt to be too high by the amount of the lower efficiency of the construction organization, and too low by the amount of overhead that a contractor pays for and a city either avoids or charges to department expense.

Part of this overhead saving is in the fact that a community's construction organization is for the job only; it does not have to be held in dull times. Part of it is in the plant charge. Thus a community can only compete with contractors on work which does not require extensive plant, or on work of a kind that is continuous for the entire life of the city. The contractor, even if he does only simple work, must have efficient tools to meet the present strong competition, and must have enough plant to carry on several contracts at once. The conclusion is, then, that this class of costs may be relied on only as a basis, with due allowance made, for engineers' estimates, or for estimates where doing work by day labor is contemplated.

Published costs of the second class nearly always omit not only the main plant charge and overhead expense of the company, but also the same expenses of the very job on which the cost data are gathered. They are, therefore, more misleading than the first class. Such data include statements, seen in the engineering press, that such and such a plant turned out so many yards of concrete, at such a unit cost, or that so many feet of tunnel were driven by certain methods, with so many men paid such and such wages. Statements like this are made only with the idea of indicating that the layout or method employed is an advance in economy over previous systems. Nevertheless, men not familiar with a certain class of contracting have actually used data of this kind in bidding on work. Usually, too, the data are quoted in reference to a special performance under favoring conditions. In using them as a bidding basis the bidder assumes that he will have such favoring conditions all through his job. Consequently, he loses heavily. Further, it is not possible in the space available in the usual article to give all the conditions affecting the costs quoted. Without these conditions being thoroughly known estimates made from such data are apt to prove extremely unreliable.

Nothing can ultimately be hid in the contracting business. A new way of organizing work, a more economical plant layout, or money-saving methods in the overhead organization are all bound to be the property of everyone in a relatively short time. Either competitors originate similar methods, or employees or mutual friends, like material salesmen, carry the ideas about. No one organization can hope to monopolize all the construction brains in the country. There is, then, no valid objection to publishing organization and construction details in the technical press, though some men have been blind enough to blame that press for losses really traceable to other causes.

With cost data, gathered for the definite purpose of making a firm's living at considerable expense and for a certain line of work, the case is entirely different. Since no contractor has a monopoly on the construction brains of the country, securing work by bidding resolves itself into a question of which firm has the plant and organization available to do the job by the cheapest known methods. In hard times firms have sometimes taken work at a loss, because their organization was idle. To have it remain so would have been a greater burden than that deliberately assumed by bidding too low. Where competition is as keen as it has been during the current year, the most accurate and complete information on costs must be in the hands of every firm that is to keep its head above water. This condition shows that there are already more than enough competitors in the field. Therefore, the present economic situation in this field, especially in large centers and on large work, needs the closest study by any persons intending to venture into a construction field new to them.

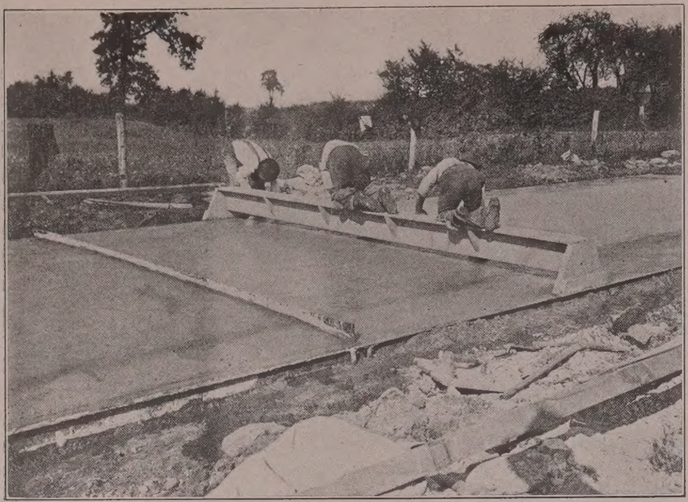
It is, then, hardly fair to the firms already in business, especially at present, to publish information gained by these same firms at considerable expense to themselves. Such cost data would be used to increase competition even faster than it increases naturally.

Timber Branding Now Assured

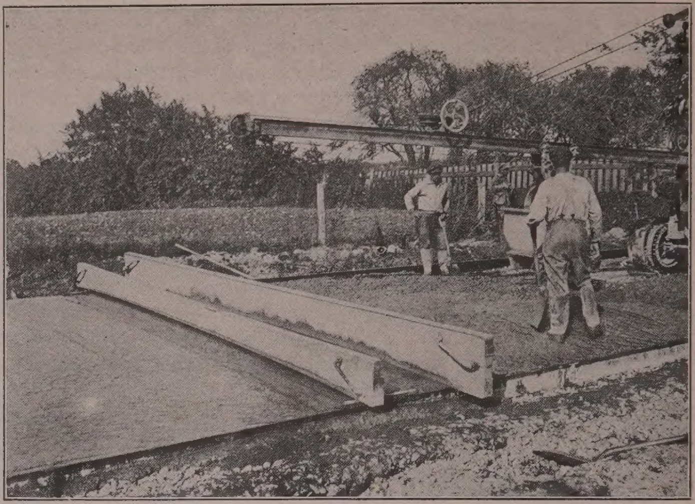
BRANDS for structural timber have been advocated by this journal for some time and from present indications much of the longleaf yellow pine timber in the future will receive a mark of some kind to identify it. One lumber company, which has practically nothing else but longleaf to sell, marks its product with the name of the town where it operates. Seven leading mills of the Calcasieu district of Louisiana have joined in the adoption of a common trademark and brand, in which the significant term "longleaf" is prominent. Another Louisiana concern is using its name as a brand under which is claimed "every desired factor in longleaf." Doubtless by this time other mills have adopted similar methods to insure the engineer and architect in getting longleaf yellow pine when he specifies it.

Another progressive step on the part of the lumber manufacturers is the adoption by the Southern Pine Association of the "density" rule originally formulated by the U. S. Forest Service, and in use for some time by the Isthmian Canal Commission in making purchases of structural timbers. This, together with the recent visual test methods for distinguishing longleaf yellow pine, puts the inspection of heavy timbers on a scientific basis so much desired by the structural timber user. In addition to adopting this rule the Southern Pine Association recommends to its subscribers that each piece of timber be branded at the mill according to grade.

While many merchandising difficulties between manufacturer, broker, wholesaler and retailer may arise from such a radical departure on the part of the manufacturers, they should not affect the ultimate consumer if he knows what he wants, specifies it, and sees that it is delivered. He has now a comparatively simple method of ascertaining what is good material with a guarantee back of it. To the complaints and strictures of many (not all) engineers and architects as to their inability to get suitable timber for structural use is no doubt due this revolution in the lumber industry. Now that the mills are meeting them more than half way they should inform themselves fully on the subject and take advantage of a much improved condition.



WOOD FLOATS AND RADIUS EDGERS USED IN FINISHING



TWO STRIKE BOARDS USED TO PREVENT WAVY SURFACE

Pennsylvania Builds Concrete Road as Object Lesson

Batches Mixed 90 Seconds Are Homogeneous and Easily Worked—Reinforcement Used—Materials Accurately Distributed by Nearby Trolley Line—Plant Selected with Care

TO SERVE as a model, both in quality of finished work and in construction methods, the Pennsylvania State Highway Department is building with its own forces a 16-ft. concrete road between Bethlehem and Easton, a distance of 8½ miles. In this work the cement companies of the Lehigh district are co-operating by supplying all cement free of charge and by sending engineering representatives to observe the methods used and offer suggestions based on a wide experience with concrete road construction in other States. Among the construction features of this object-lesson road are the thorough compacting and underdraining of the subgrade, and strict adherence to established grades. Every batch of concrete is mixed 90 sec., and sufficient water is used to make the concrete plastic, so that it does not quite level down in the discharge bucket. Since the dolomitic limestone used was proved by tests to have practically the same resistance to abrasion as the mortar, a 1:2:3 mix is used, thus insuring an easily-worked, homogeneous concrete.

On the theory that the cracks in concrete roads which are not reinforced are of surface origin, the slab length has been increased to 39 ft. 6 in., and Kahn road-mesh reinforcement, placed 2½ in. from the top, is used to eliminate longitudinal cracks caused by settlement of the shoulders. An extra-heavy strike board, followed by a lighter one, insures the thorough compacting of concrete and eliminates the formation of rolls in the surface. The broomed finish has been discarded in favor of the wood-float finish. At expansion joints a 3/16-in. radius edger is used, and at the sides a ¾-in. radius edger. This is expected to eliminate chipping. At present eight test cubes each week are taken from the regular batch of each mixer, and these cubes are tested after 7 days, 14 days, 28 days and 6 months.

Modern Construction Methods

Full use is being made of the resources of the territory in which the road lies to secure the cheapest acceptable road materials. Up-to-date road machinery in the most economical units is employed. The trolley line which parallels the road handles the distribution of stone, sand and cement. A small quarry available midway between Bethlehem and Easton has been opened. Two portable crushers are used, and the bins discharged into the cars on a spur from the trolley line. This quarry is supplementing the available supply of commercial stone, and cutting costs. The tailings and fine stone from these crushers are used in drainage ditches and on the shoulders of the finished road. The rock excavated in grading is crushed in a portable gasoline-driven "coffee-mill" crusher, and is used to cover the tile drains, which are laid in advance of concreting. The work was begun in the middle and is being carried in both directions toward Bethlehem and Easton by two completely equipped crews.

Order of Construction

After the rough grading is done the subgrade is finished and rolled while the drains are being put in. The concrete crew, the finishing crew and the curing work follow in order, after which the earth used to cover the concrete is made use of by the "trimming-up" gang. Special attention is paid to the proper distribution of concrete materials, and rehandling has been practically eliminated. The sand and stone cars are spotted by the foreman at measured distances from the end of the last concrete. The men are distributed with care to insure uniform progress of each operation, from the rough grading to finishing the shoulders.

Road Foundation

The present road-bed is of clay, mostly without heavy cuts or fills. All fills are made in 1-ft. layers and thoroughly rolled with a 10-ton roller, one of which is provided at each end of construction. Adequate longitudinal and transverse porous tile underdrains are being installed. Corrugated iron pipes are used to pass water under the road-bed where necessary, and concrete box culverts are built in advance of concreting to care for small streams and heavy watersheds. The side drains are of 4-in. porous tile, and are laid on ½ x 4-in. boards to maintain an even grade. They are set 18 to 24 in. below subgrade and laid with a covering of one-ply tar paper,

LOCAL QUARRY WORKED WITH PORTABLE CRUSHERS TO CHEAPEN STONE SUPPLY wrapped around each joint, with the lap on the bottom. This paper contains little tar and will allow easy ingress for the water at joints. This method provides a joint which is thought to be considerably stronger and which is expected to last longer than the bagging joint generally used. The ditches are backfilled with tailings from the crusher plant and with stone from the grade cuts.

Grade stakes are set every 25 ft. and the subgrade is finished very accurately. It is rolled until thoroughly compacted. Although an effort has been made to spend no more money on this work than the saving of concrete justifies, a majority of the slabs have been laid with less than 4 per cent variation from the theoretical volume and several have run the exact computed yardage.

CONCRETE WORK ARRANGED ECONOMICALLY

Stone is loaded directly into the cars of the Easton Transit Company at Bethlehem and at the small quarry. Sand and cement, the former coming from a sand dredge at Succasunna, N. J., is transferred from the railway to trolley cars at Taylor Road, outside of Easton. The sand grades from fairly fine to pea gravel, and, being dredged, is very clean. Cement is stored in portable canvas sheds holding 90 sacks each, placed at measured distances along the road, and carried ahead as they are emptied. Accurate measuring of the sand and stone is accomplished by wood-box barrows of special design and of 3 cu. ft. capacity, shown in the photographs. They are struck off with a shovel. One No. 16 Koehring mixer of 3-bag batch capacity is used on each end of the concrete work. These machines have a boom delivery. The side forms are made of 6-in. channels in 12-ft. lengths, held in place by steel stakes. The finished concrete is 6 in. thick at the sides and 8 in. at the center, and is being laid on a level subgrade. The subgrade is sprinkled with a hose before placing concrete.

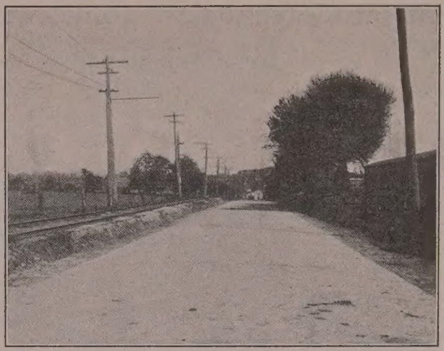
The reinforcing comes in sheets 5 ft. 2 in. wide, and in lengths of 6 and 10 ft. It is laid with lengthways joints staggered, and with a lap of 4 in. crosswise of and 12 in. parallel to the roadway. Expansion joints are made by tying two 9-in. x 16-ft. strips of $1/8$-in. Elastite to a 9 x 16-ft. plate. This assembled form is securely placed with the Elastite next the slab being finished. Concrete is poured on both sides of joint, that on the back side is struck off, the strings are cut and the plate pulled out by handles, leaving the joint in place. After the concrete has set for 24 hr., the joint material is trimmed off $1/2$ in. above the concrete surface.

The concrete crew is organized with three finishers, two men who handle both strike-boards, three men placing concrete and reinforcing, one mixer engineer, one fireman, one charging man, two men on forms, three men on cement, and from eight to twelve men on stone and sand. Although every batch is mixed 90 sec., this crew can place more than eight slabs in a 10-hr. day, making more than 100 cu. yd.; seven slabs can be run without crowding.

ROCK FROM CUTS USED BY CRUSHING IN PORTABLE "COFFEE MILL"

LET CONCRETE SET A DAY BEFORE COVERING

Under a very hot sun the fresh concrete is protected by canvas. On cool days it is simply wet occasionally with a hose. After 24 hours the forms are removed and the surface is covered with a few inches of dirt. This is wet night and morning for 10 days, and is removed after 14 days and placed on the side slopes or where needed. All traffic is kept off the subgrade, and as all materials are delivered by the trolley line, which parallels the road, there is no occasion for even construction wagons to use the subgrade after it has been finished. This permits keeping the rollers about a half a mile in advance of the concrete crews.


FLOAT FINISH GIVES SMOOTH ROADWAY

METHODS OF PLACING CONCRETE MATERIALS HAVE OBVIATED ALL RE-HANDLING

RAPID AND ECONOMICAL PROGRESS EXPECTED

Although the work has been in progress only three months, practically 4 miles of the $8\frac{1}{2}$-mile stretch have been graded, 3 miles subgraded, and 2 miles concreted. This has been done although labor has been hard to get, and although stone deliveries were so slow at first as to keep one mixer idle a large part of the time. Steel mills in the vicinity are very busy, and men shipped from outside to recruit the camp of 150 laborers maintained are hard to hold.

The work is being done under the direction of William D. Uhler, chief engineer of the Pennsylvania State Highway Department, and George H. Biles, second deputy highway commissioner. J. T. Gephart, Jr., is acting engineer of the district in which the road lies, and J. E. Sampson has entire charge of the work as superintendent for the State Highway Department.

Two-Foot Water Head Straightens Distorted Soo Lock Gate

INJURY to the north leaf of the lower operating gate of the third lock at Sault Ste. Marie put the lock out of commission for 41 hr., from 3 a. m. to 8 p. m., Oct. 19.

When the leaf was being closed it was caught by the current running out of the lock and carried along to the sill, which it struck with such force as to spring the top of the gate, putting the toe post about a foot out of plumb. To make certain that no other damage had been done, the lock chamber was pumped out, permitting thorough examination. After attempts to straighten the leaf by the use of jacks and turnbuckles had proved unsuccessful, water was again let into the chamber, and after mitering the two leaves at the top the water was allowed to come up on the gate. Under about 2 ft. of head the distorted leaf straightened and mitered, so that there was practically no leak at the toe, though there was doubtless some along the sill. When not under pressure, the toe post is still 5 or 6 in. out of the vertical, but the gate is operating successfully. After the close of navigation such repairs will be made as seem necessary.

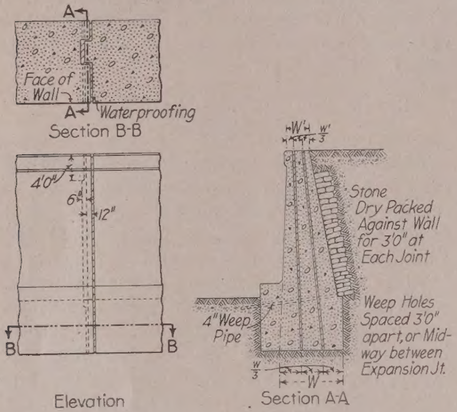
Discuss Expansion Joints for Concrete Structures

C. F. Bedwell and H. G. Throop Illustrate Typical Methods for Waterproofing and Providing for Temperature Changes

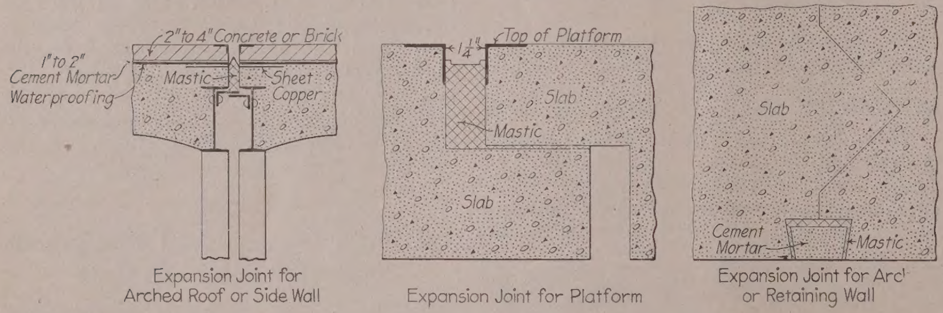
REPORTING to the committee on buildings and structures of the American Electrical Railway Engineering Association at the recent San Francisco convention, C. F. Bedwell and H. G. Throop described the methods to be used for proper provision for expansion and contraction in concrete structures and for waterproofing the joints. A few of the more typical forms of construction recommended are illustrated in the abstract which follows:

REINFORCEMENT NEEDED FOR RESTRAINED STRUCTURES

The stresses resulting from a drop in temperature of about 15 deg. Fahr. will stress the concrete in a restrained structure sufficiently in tension to cause excessive cracking unless properly reinforced with steel. To prevent these excessive cracks from being noticeable, although minute cracks will still remain, about 0.4 per cent of steel reinforcement should be placed near the exposed face of the wall. No amount of steel will entirely eliminate cracks, but the greater the percentage of steel the smaller will be the cracks. Small rods spaced close together, or a mesh, should be used rather than large rods spaced far apart.


A
Face of Wall
A
Waterproofing
Section B-B
4'0"
6"
12"
B
B
Elevation
W'
W'/3
Stone Dry Packed Against Wall for 3'0" at Each Joint
4" Weep Pipe
Weep Holes Spaced 3'0" apart, or Midway between Expansion Jt.
W/3
W
Section A-A

DETAILS OF RETAINING WALL JOINT



Expansion Joint for Arched Roof or Side Wall

Expansion Joint for Platform

Expansion Joint for Arch or Retaining Wall

TYPICAL FORMS OF EXPANSION JOINTS FOR VARIOUS STRUCTURES

Reinforced-concrete slab bridges should be limited to spans of about 35 ft., because it is difficult to allow free expansion at one end of such bridges to prevent temperature stress.

When a fence, railing or coping wall is restrained or is part of a restrained structure, expansion joints should be provided about every 30 ft. The change in temperature is commonly taken to be 50 deg. Fahr. and the coefficient of expansion for both steel and concrete to be 0.0000065.

Two types of expansion joint for plain concrete retaining walls and for platforms or slabs are illustrated herewith. The proper use of waterproofing and mastic is indicated, and the necessity for drainage back of the retaining wall joints is recognized.

Expansion joints also serve as settlement joints and eliminate the danger of a retaining wall face being ruined by cracks caused by slight uneven settlement in the footing. In a reinforced wall the steel will reduce shrinkage and contraction cracks to a minimum and hold the wall true to line and grade where a plain wall might settle. It is possible to erect considerable lengths of reinforced wall without expansion joints.

Atlanta Burns Its Garbage for 91 Cents per Ton

E. R. Conant Gives Detailed Cost Data of 130-Ton Mixed Refuse Destructor—Clinker Successfully Used for Road Surfacing

DETAILS of unit cost for burning mixed garbage at Atlanta, Ga., for a 1-yr. period, during which 26,795 tons were cared for, were given in a paper at the Dayton convention of the American Society of Municipal Improvements by E. R. Conant, chief engineer. Operation cost 55.65 cents per ton and maintenance 4.52 cents. A credit for steam produced and sold amounted to 20.33 cents per ton, leaving a net cost of 39.84 cents. To this was added 2.16 cents for labor in the tipping room, and 3.24 cents for weighing. Clinker removal at 8.79 cents less 3.36 cents credit for its sale left a charge of 5.43 cents, making the total of 50.67 cents for all but interest and depreciation. Interest on $127,000 at 4 per cent amounts to 18.47 cents per ton, and depreciation was estimated at 22.18 cents, giving a total cost of 91.32 cents.

Mr. Conant stated that the plant had not been shut down in 1½ yr. but once or twice, and then for less than a day.

CONTENTS OF REFUSE

The refuse delivered to the plant consists of 40 to 45 per cent of garbage, approximately 50 per cent of rubbish and 5 to 10 per cent of ashes. In the rubbish there is a great amount of tin cans and other indestructible matter. During the watermelon season in July and August the amount of garbage is largely increased. This year it averaged 15 tons per day and last year 20 tons per day. During these two months when there is an excess of garbage there is added to the refuse hopper about 10 per cent additional weight of ashes and cinders collected in a pile during the season when it is not necessary for consuming the garbage. The only labor cost involved is the wheeling of the cinder from the storage pile to the hopper. No other fuel is used.

The clinker from the plant varies from 20 to 30 per cent, according to the cinder. About half the clinker by weight is more or less vitrified. At first it was believed that this clinker would have no value, but after a trial in using it for a foundation for hardening streets it was found that it is well adapted for this purpose. Streets that have been hardened with the clinker have been in use for over a year. The streets so treated stand up under heavy traffic, and are found to be far more durable than those surfaced with gravel. A considerable quantity of the clinker is sold to property owners, who pay a nominal price for it. In one instance seventy-five cars have been filled and hauled by railroad 25 miles to be used as a foundation upon beach sand over which gravel was placed. This 2-mile roadway has stood up very well. The tin and sheet iron oxidizes and compacts with the ash and carbon, making a solid foundation strata.

Long 15-Ton Guy Derrick Folds Into Compact Form

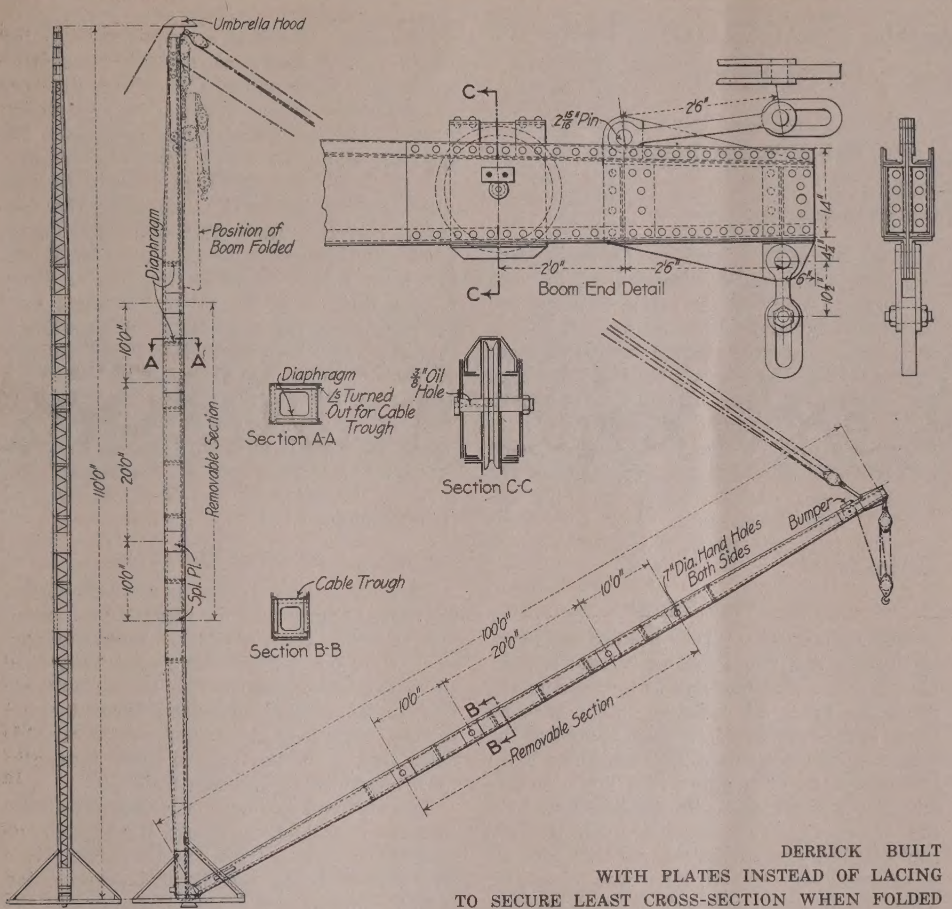
Ball and Socket Umbrella Hood Replaces Usual Gudgeon Pin at Top of Mast—Plates and Angles Reduce Mast and Boom Sections

IN CONSTRUCTING a skyscraper built recently in Chicago the contractor desired a compact 15-ton derrick to place floor framing to the base, which could be raised through a small opening after the floors were erected. For this purpose the mast and boom were made of angles and plates, thus reducing the combined thickness at the center of the two when folded to 56 in. Other features of the derrick are an umbrella ball-and-socket hood at the top of the mast instead of the usual gudgeon pin, a ball-and-socket base, a removable bull wheel and the attachment of the boomfall line back from the end of the boom so as to give a reverse bending moment in the boom, tending to offset the moment due to the weight of the boom itself.

The derrick consists of an all-steel 110-ft. mast guyed by eight lines if desired, a 100-ft. boom and a bull wheel 14 ft. in diameter. The mast and boom each have one 20-ft. and two 10-ft. removable sections put together with bolted splice plates.

BALL-AND-SOCKET UMBRELLA HOOD

At the top of the mast a specially designed umbrella hood with a ball and socket provides for the attachment of eight guy lines. The ball and socket gives sufficient play to make the tension a direct pull during the ordinary working of the derrick when the mast is not quite plumb. The hood proper containing the socket is made up of upper and lower plates bolted to a cast-steel socket, a ring casting in two parts being placed below the lower set of plates to prevent jumping off when the collar begins to bear on the conical surface below the ball, and during erection or dismantling. In cross-section about 240 deg. of the ball is covered. The upper plate is cut from a single octagonal piece, but there are eight lower plates. In calculating the stresses it was found that the critical section is on the lower ring casting just within the bolt circle. The maximum load occurs when one of the guys is carrying all of the load and the phosphor-bronze ring is bear-



DERRICK BUILT WITH PLATES INSTEAD OF LACING TO SECURE LEAST CROSS-SECTION WHEN FOLDED

ing on the conical surface below the ball.

The cast-steel ball, of 8-in. diameter, is finished all over and cored out to give a thickness of 1½ in. Below the ball portion of this casting are three heavy ribs to provide attachment for the top of the mast and the boom-fall links. The outer ribs are bolted to gusset plates extended from the sides of the mast, while the central rib carries most of the load of the links for the boom fall. As the center line of the hood is over the front face of the mast, an extra plate is used on the back to care for the large bending moment produced. This offset arrangement was necessary to keep the hood, which requires about 4½ ft. clearance, within the same plan area as the boom and mast when the latter are folded up.

MAST AND BOOM OF PLATES AND ANGLES

While a still more compact mast might have been made by covering all four sides with plates, the back side was laced and the section increased somewhat because accessibility is a feature that could not be overlooked. The lacing provides a ladder which could not be obtained so cheaply any other way. As the boom can be got at easily, plates were used on all four sides. To provide troughs for the ropes and make riveting of sections possible, the angles on the face of the mast and on the top of the boom are turned out.

The boom-fall line is brought out of the mast near the top at a point to clear the boom when the derrick is folded so as to be accessible and to clear the removable sections, which have several plate-steel stiffener diaphragms.

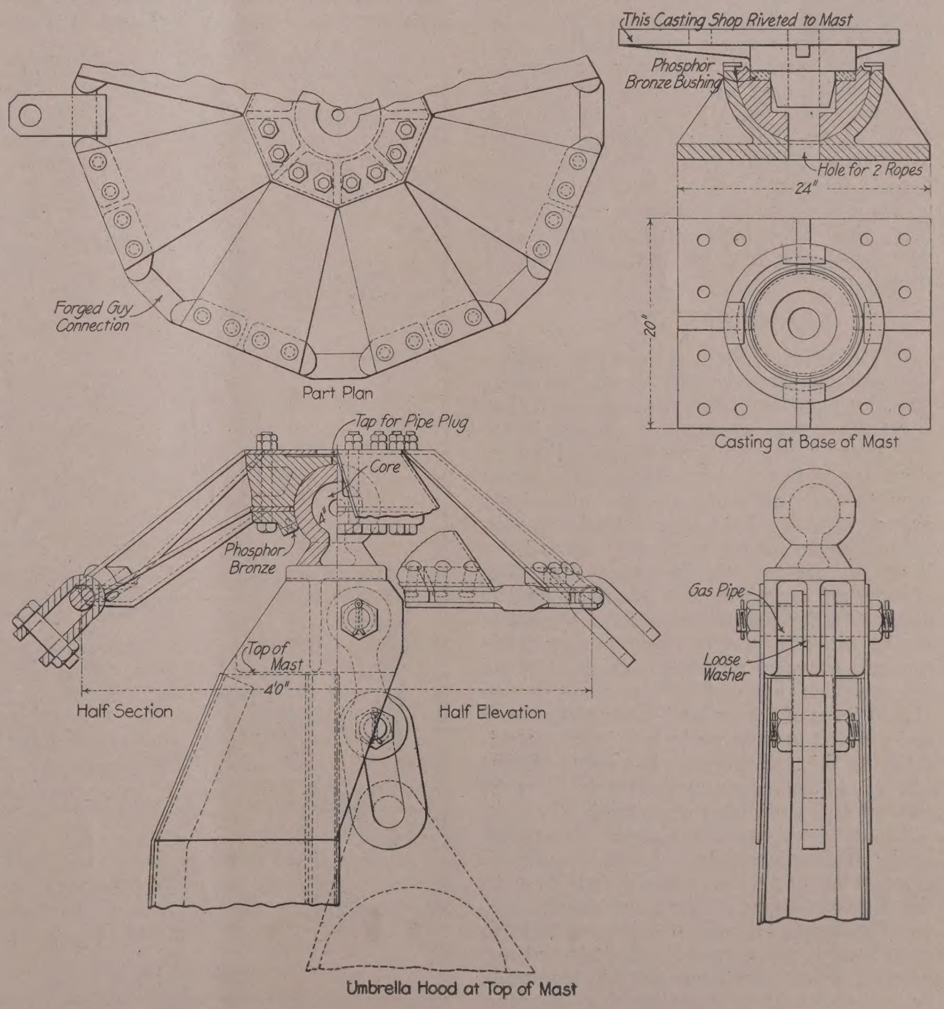
TWO BASE BEARINGS

As at the top, movement of the mast from plumb is cared for at the base by a ball-and-socket joint. There is, however, another smaller horizontal bearing surface on which the mast rotates when turned by the bull wheel. The vertical surface of the phosphor-bronze bushing must take all horizontal thrusts and transmit them to the bowl casting, which is bolted to the floor or foundation. The lower part of the casting bolted to the mast is tapered so that the mast can tip considerably during erection and dismantling. Four clips hold the ball and bowl castings together and keep the surfaces clean and free from injury when the derrick is knocked down. The 3-in. hole through all three castings is sufficiently large to pass the two cables even when the mast is somewhat out of plumb.

REVERSE BENDING MOMENTS INDUCED

To put a reverse moment in the boom to overcome the bending moment due to its dead weight, the boom fall is attached 2½ ft. back of the load fall pin. An additional reverse bending moment is produced at the foot of the boom by placing the pin below the center line. The attachment of the boom and load fall links at the end of the boom to a single central plate heavily reinforced is shown in the detailed drawing. Protection of the load-fall sheave carrying the line to the upper side of the boom is provided by a front plate which also acts as a bumper when the boom is folded against the mast.

This derrick and a duplicate were built for the Ketler-Elliott Erection Company and first used on the Marshall Field addition in Chicago.



DETAILS WHICH INSURE CORRECT STRESSING AND EASY OPERATION

Engineer of Modern Sugar Plantation Has to Deal with Varied Problems

Plant of Niquero Company in Cuba a Good Example of the Various Classes of Construction Required for a Well-Balanced Plantation

By SAMUEL VICKESS
Consulting Engineer in Sugar Factories and Estates, New York City

MANY KINDS of construction of considerable magnitude enter into the development of the modern sugar plantation, and the engineer is a very great factor in its eventual success or failure. His work may include the surveying and mapping of great tracts of forest land, their subdivision into smaller parts for planting purposes, the location and planning of an adequate railway system and the design and construction of docks, bridges, roads, warehouses, dwelling-houses, one or more mills, water-supply and sewer systems, a lighting plant and telephone and transmission lines.

The plantation of the New Niquero Sugar Company at Niquero, Cuba, is an excellent example of the varied problems that are met with in the development of a modern estate. This might be very aptly termed an average plantation. It is neither exceptionally large nor so small as not to require skilled laying out and operation. Its equal in size and output may be found in many places elsewhere on the island of Cuba and in other sugar-growing countries.

More than a century ago there was a small wooden mill, which is still standing, near the present plant. The annual output of this mill was 83 tons of sugar. Ten years ago, when the company purchased the property, there was a more modern plant with 2000 acres of land under cultivation, all of which was within two miles of the factory. This plant had an annual output of 3250 tons. Last year's output of the new plant was 27,300 tons. To attain this greatly increased output required ten years of gradual extension and the expenditure of more than $2,000,000 for the purchase of new land, new installations and new construction.

Land Extension

Of the original 2000 acres under cultivation not one acre is still in use for cane-growing purposes. The percentage of yield from sugar cane decreases to a certain extent every year. In time, to make the continuance of the field profitable, it is necessary to fertilize and cultivate intensively or, on estates where virgin land is available at cheap prices, to plow it up and use it as pasture for the feeding of the large number of oxen that are required on the plantation for hauling cane from the fields to the railroad, and to open up new fields for cane-growing purposes. Such has been the practice adopted at Niquero, where 12,000 acres of forest land have been cleared and planted in cane up to last year. In addition to this the company has acquired control of 40,000 acres more which must be cleared and cultivated as needed.

In all there are 3000 acres of pasture land. These lands in themselves require more work to prepare than do pastures in the United States. There are no all-year-round running streams at Niquero, and the oxen have to be supplied. To this end numerous wells have been drilled, windmills or gasoline motors installed for pumping and pipes laid to distribute the water.

The land under cultivation for cane-growing had to be cleared, stumped, subdivided, plowed and planted. A system of roads had to be laid out and built, and bridges had to be constructed over stream beds and other depressions. These expenses have not been undertaken blindly, however, as experiments have been under way at Niquero for some time to determine the value and cost of fertilization and irrigation, and, in the future, these pasture lands will be cultivated intensively and used for cane-growing purposes again if the tests result satisfactorily.

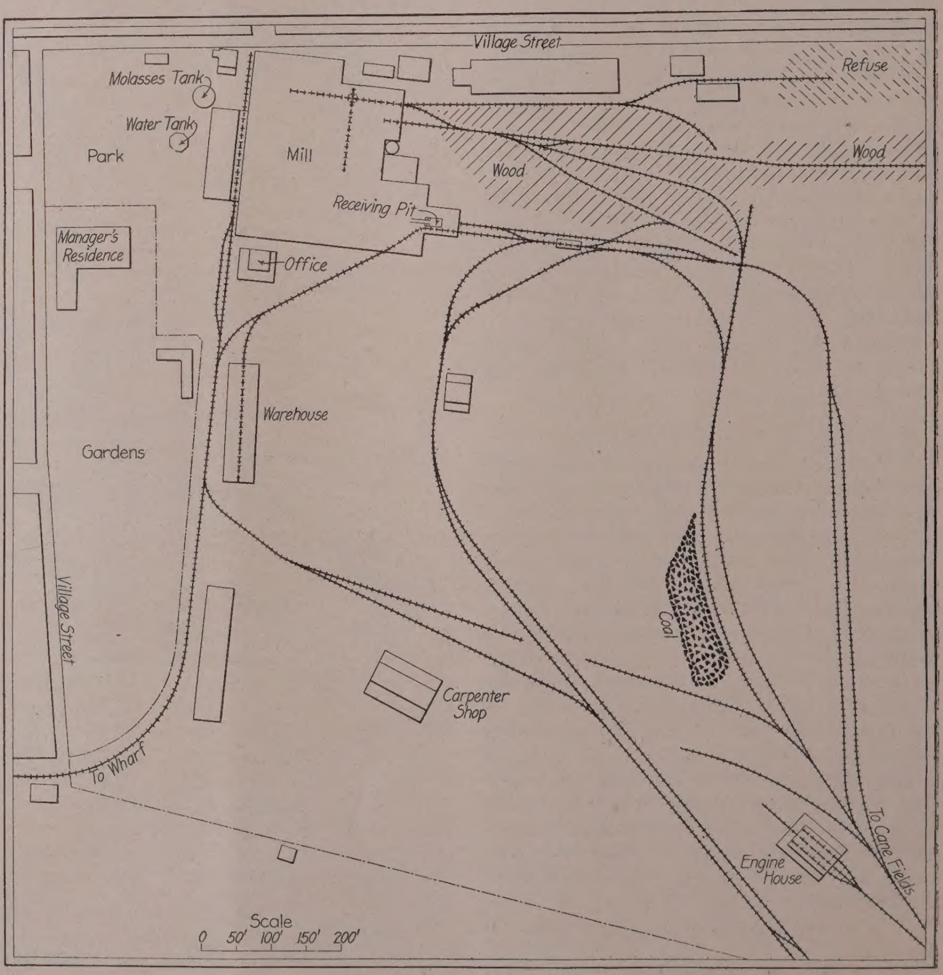
Railroad System

When the company took hold of the property there was not a foot of railway on the plantation. The cane had to be transported from the fields all the way to the mill by oxen, and the finished product hauled to the wharf by the same primitive method. With the exception of a short line down to the wharf the same methods were followed by the New Niquero Company until the exceptionally large output—for a mill without a railroad—of 13,000 tons was obtained. Then, to increase the output, and because the fields were reaching out to considerable distances, work was started on a railway system. This at present consists of about 22 miles of track. A 3-ft. gage is used, and 45-lb. rails. There is a main line, starting at the factory terminal yard and running to a country yard named Ceibabo, a distance of about 4½ miles; a north branch, which goes to another country station named Niquerito, about 10 miles from the factory, and a south branch, which goes to Coloraditas station, about 4 miles from the factory. Several minor extensions have been added to these lines in the last few years, and more will be added in the future. Each of the lines required several bridges over watercourses, three of them being of fair size and costing about $7,000 each, exclusive of lumber, which was to be had almost at the cost of cutting. Cuts were very largely avoided, but considerable filling and embankment was involved. Ties are of hardwood, cut on the property. The wharf line is about 0.6 mile long and of especially good construction.

Cost and Equipment

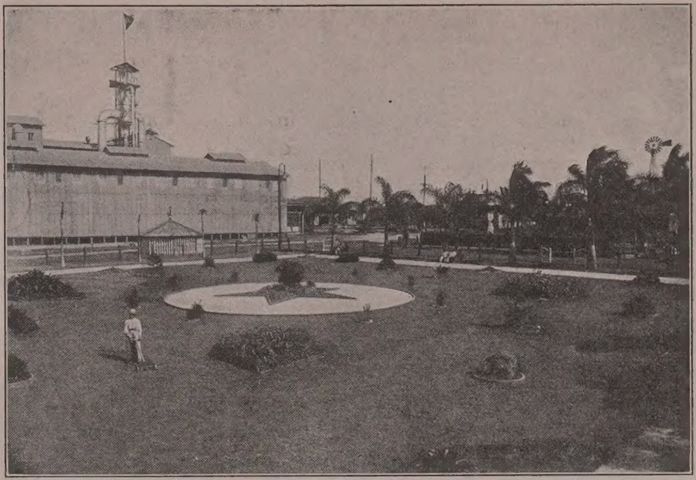
Concrete pipe culverts were used wherever practicable and, in many cases, open-top concrete structures. During the past year worn-out boilers have also been used for culvert purposes. The larger culverts had to be studied out very carefully and provision made to accommodate the variable flows that occur during the rainy season in the ordinarily dry stream beds.

The railroad grades, on almost all of the lines, are descending toward the factory, so that there is little work for the locomotives with loaded trains, and the fuel consumption is low. The branch from the factory to the wharf is so graded that by simply pushing the loaded car at the former point it will travel to its destination by gravity alone.



LAYOUT OF FACTORY YARD HAS MUCH TO DO WITH EFFICIENCY OF MILL

WATER SUPPLIED FROM TANK 68 FEET HIGH



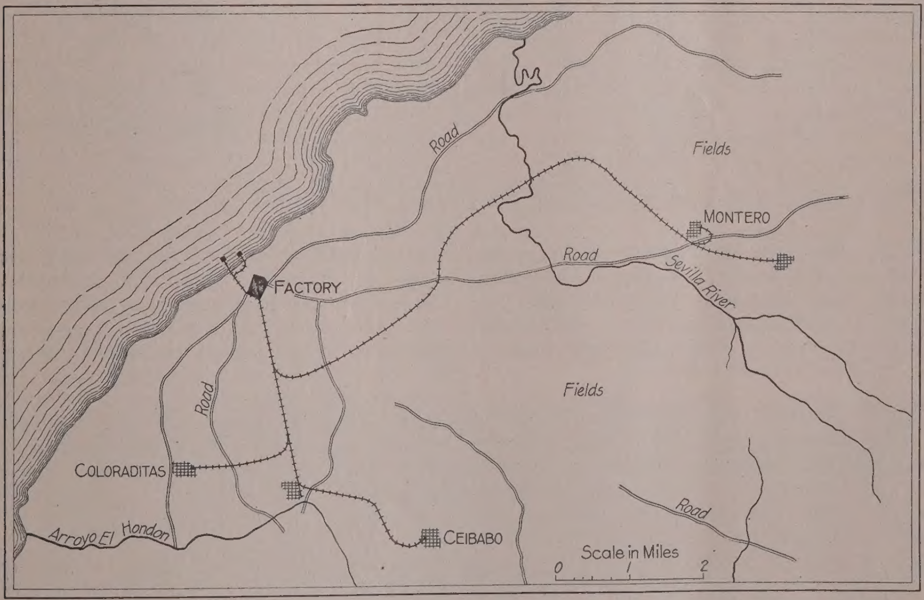
ATTRACTIVE SURROUNDINGS A NECESSARY PART OF WORK

The railroads cost, on an average, about $10,000 per mile.

Each of the country receiving stations has an area of 33 acres. They are equipped with scales, cane transporters, wells, pumps, water tanks and loading sidings. The railroad equipment consists of 96 wooden cane cars, 79 steel cane cars, 6 flat cars, 2 box cars, a passenger car, 2 coaches, an electric car, hand cars, 3 tank cars and 4 locomotives.

FACTORY TERMINAL YARD AND MILL

The main terminal yard is equipped with such sidings and appliances as are necessary to make the discharging of loads and handling of cars possible with the utmost dispatch and to provide for the storage of cane and empty cars sufficient for the night work. This yard is very important in sugar-mill design. A car congestion there would be very costly. The mill works 24 hours each day and the volume of the cane is large as compared with that of the sugar that is obtained from it. There are mechanical devices for unloading a whole car into the receiving pit at one time, and a chain-belt elevator to carry the cane up to the crushers and mills. The layout of the yard is shown in one of the accompanying drawings.



RAILWAY SLOPES GENERALLY TOWARD MILL, MAKING WORK OF LOCOMOTIVES LIGHT

The tilting table for unloading at Niquero has proved to be an effective and economical device. It consists of a platform of sufficient width and length to accommodate one car. The loaded car is pushed on it, whereupon the outer side is elevated by hydraulic pressure until the cane slides off the car of its own weight and into the receiving pit.

The mill building is steel framed, and walled and roofed with galvanized iron sheets. It is equipped with all the necessary machinery for the manufacture of raw sugar. The warehouses are single storied and are also constructed of steel and iron.

The chimney at the mill is of steel, 180 ft. high by 16 ft. in inside diameter at the base, tapering to a 10-ft. diameter 40 ft. up. It is set on a concrete foundation.

There are also several tanks for the storage of molasses, a by-product obtained in the process of sugar-making. This material weighs 90 lb. to the cubic foot, so the tanks required rather elaborate foundation work. Piles spaced to 4-ft. centers each way were driven to a 15-ft. penetration. They were then capped and a 3-ft. thickness of reinforced concrete was spread resting on them, which provided a foundation for the tank as well as a floor.

MUNICIPAL WORK

The water supply is pumped from wells to a tank 68 ft. high, with a capacity of 50,000 gal., from which it is distributed to the various buildings and yards.

The sewer problem at Niquero was very simple. Two lines of 18-in. vitrified pipe sewer, each 2000 ft. long, were laid to carry the sewage from the buildings down to the sea by gravity.

A sugar plantation is a small settlement in itself, apart and removed from the nearest habitation. Its operation requires the employment of skilled men who are accustomed to life in developed countries. To make it attractive to them it is necessary that the ornamental as well as the practical features be taken care of. To this end the New Niquero Company has laid out and established an attractive park on its property. The employees' houses are excellently constructed after the American style, modified to suit tropical conditions, and are equipped with running water, electric lights and all the sanitary fixtures, such as flush toilets, baths and other conveniences as are usual in the United States. The company has also encouraged every movement toward modern improvements in the village as well, such as clean streets and sanitary measures, the recent installation of an electric light plant and the building of a club house for recreative purposes.

WHARVES AND BRIDGES

There are two wharves at Niquero. The principal one is 1400 ft. long exclusive of the terreplane approach. It rests on hardwood piles driven down to rock. These are 15 in. in diameter at the butt, 8 in. at the toe and from 35 to 45 ft. long. They are spaced at 6-ft. centers each way. The stringers and caps are of cross-sectional area much greater than the highest possible load would require, as the lumber is so cheap that it is more economical to use it than to cut it down. The flooring is of yellow pine. The approach is of sufficient width to accommodate a single-track railway. The wharf proper is 54 ft. wide and accommodates two railway tracks as well as providing space to pile 12,000 bags of sugar. Boats drawing 13½ ft. of water may tie up directly alongside. The second wharf is 400 ft. long and is also constructed of hardwood with a yellow-pine flooring.

The bridges, as a rule, consist merely of concrete abutments and a timbered stringer under each track, but in places where the watercourses are swollen periodically out of all proportion to their usual state more elaborate structures had to be built. One of the latter, which is thoroughly typical of its kind at Niquero, is shown on an accompanying drawing. This is 121 ft. between abutments. Bents of hardwood rest on piles driven to approximately 12-ft. centers and capped. At the channel proper there is an 18-ft. span. This is of 12 x 12-in. hardwood strengthened by iron truss rods. The reason for this span is to avoid an obstructing bent that would collect floating débris and stop the flow so as to endanger the railway embankment.

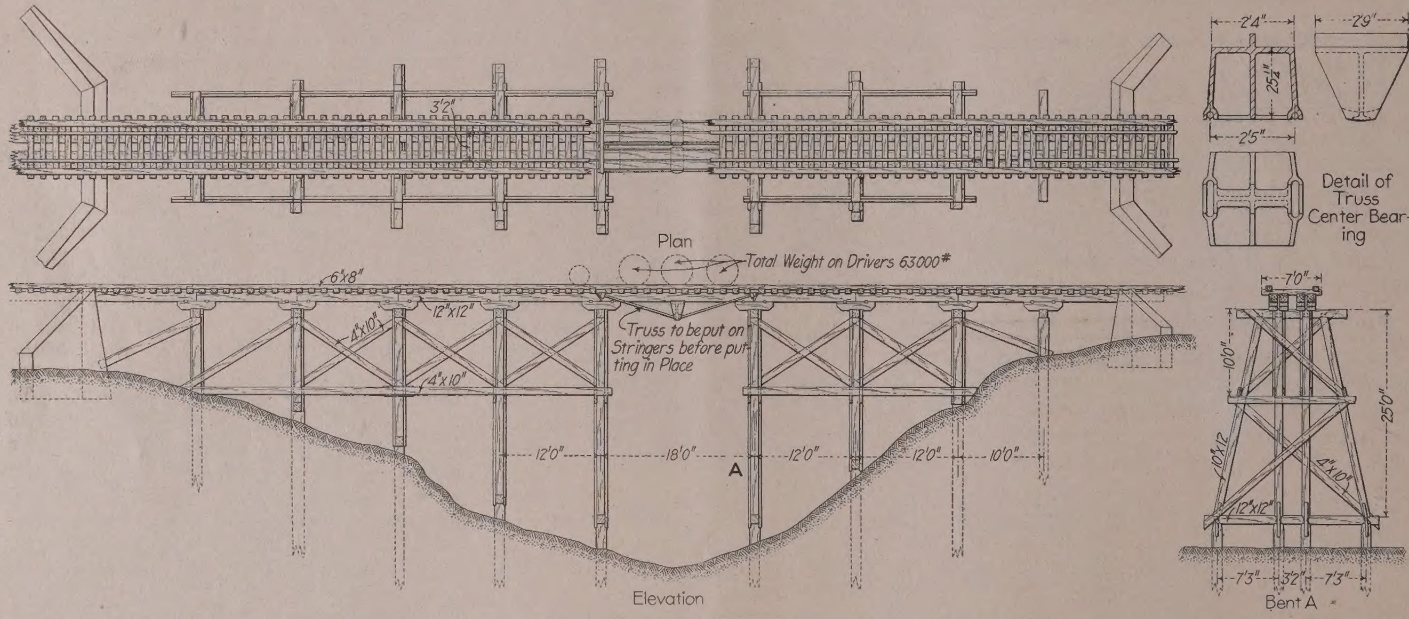
Lighting and Telephone

The property at the mill is lighted by electricity developed in a private plant. The town is lighted from a municipal plant. Both of these plants have been installed within the last six years.

The company has installed a telephone system on its property that connects the factory office to all important offices, to all zone guard houses and to the different country freight-gathering stations. There is also an ice-manufacturing plant, a laboratory, machine shop, carpenter shop and sawmill. All these are completely equipped to serve their intended purposes.

Though working at nearly full capacity the Niquero plantation can by no means be said to be completed. In fact it may be aptly termed, "still under construction." More fields will have to be cleared from year to year, railroad extensions will have to be made and considerable additions to the factory buildings and warehouses are already projected.

The New Niquero Sugar Company is an American concern, with offices at 129 Front Street, New York City. J. H. Post, of B. H. Howell Sons & Company, of New York City, is president, and the writer is consulting engineer. All of the work was done under the personal direction of Ricardo Narganes, vice-president and general manager of the company, who has been affiliated with large engineering projects in Cuba for many years, having been general manager and representative in Cuba for Runkle, Smith & Company, contractors, on the construction of the Palatino Reservoir and the original distribution system of the Havana water supply, general manager of the Matanzas Gas & Electric Company, constructor of the Camaguey Electric Company and, for several years, general manager of the Havana Gas & Electric Company.



TYPE OF BRIDGE USED AT LARGE WATER COURSES WHERE AN OBSTRUCTING BENT MIGHT STOP FLOATING DÉBRIS

Formulate Rules for Society Programs

Introspective Investigation of A. S. M. I. Leads to Well-Defined and Co-Ordinated Duties for All Committees

UPON the program committee of a technical society so much of success or failure depends that the following notes are taken from an exhaustive introspective investigation and report of the committee work of the American Society of Municipal Improvements. The committee on committees, consisting of A. P. Folwell, chairman, E. S. Rankin and C. C. Brown, prepared a set of instructions to committees with the idea of having them handed down to each incoming chairman so that there would be a continuity of effort and no departure from the desired field of discussion.

New chairmen begin their work in the dark as to the duties and aims of that committee. General duties consist in preparing a report and obtaining papers. The committee is urged to select some one feature to be given extended attention.

Papers on Selected Subjects Desirable

In obtaining papers for the annual meeting, instead of asking broadcast for papers on any subject, the society would be better served if each committee were to select subjects upon which it is desirable to have papers prepared, and endeavor to obtain discussions of these subjects from those best qualified to write them (whether members or not). The subjects chosen would ordinarily be those selected by the committee as the principal feature of its own report. At the same time the committee should make an effort to encourage the younger and newer members of the society to present any information which they may have on details of practice, with the idea of encouraging them to take an active part in the society so as to retain their interest. However, the committee should keep in mind the interests of the society as a whole, and eliminate as far as possible discussions of well-known ideas or descriptions of common-place work which would take up the time of the society with little resulting benefit.

The discussion in convention which is brought out by a paper is frequently more valuable than the paper itself from an informative point of view, and is especially so as giving an interesting and live convention. This idea should be kept in mind in selecting subjects and approving papers to be read before the society. In the case of some papers, such as those which contain tables and statements more or less burdened with statistics, it would be well for the committee to go carefully over the paper and note such matter as could not be readily apppreciated by an audience only when read from the printed page, and to request the author either to omit this in reading the paper before the society, or to prepare a brief statement for such oral presentation which will give the gist of the information contained therein.

A short paper full of meat is much preferable to a long one, and condensation of papers should be encouraged, but not to the point of lessening their intelligibility. There are exceptions, such as a comprehensive paper covering a wide field and endeavoring to sum up all available information on a subject; but generally speaking, 2500 to 5000 words is an excellent length for a paper, or at least for that part of it which is to be read aloud at the meeting.

Why the Traffic Census?

A TRAFFIC census is most valuable in determining the economic type of road in a large system of highways, said W. W. Marr, at the recent Northwestern Road Congress at Cedar Rapids, Iowa. "It is inconceivable that in any big system of roads the traffic will ever be the same on each road of the system. It is admitted that the traffic on a few of these roads will probably be so nearly the same that for practical purposes it may be considered identical, but some of the roads in the system will surely never carry more than a half, a quarter, a fifth, or a tenth the burden of the main roads, and if we have designed all the same, we must necessarily have wasted a great deal of money." It is necessary in an economic design of a system to consider the load burden, and this cannot be even approximated without some sort of estimate.

Pressure Test Shows Little Leakage from Huge Molded Concrete Pipe

Loss from 8000-Foot Conduit at Baltimore Only One-Third of Amount Fixed by City Water Department

PRESSURE tests recently made on long lines of 7 and 9-ft. precast reinforced pipe in Baltimore's waterworks improvements showed a total leakage rate of only 13,000 gal. in 24 hr. in an aggregate length of 8000 ft. under a pressure of 35 lb. per square inch. The maximum allowable rate of leakage under the contract was set by the city's engineers at 38,000 gal. as the result of preliminary tests on individual pieces of pipe. The 35-lb. test pressure called for in the specifications is to be the maximum actual working pressure. This is believed to be the largest pipe line of its kind to be required to stand so great a pressure.

The pipe line in question extends from the new filtration plant above Lake Montebello to the head of the distributing mains near Lake Clifton. For construction purposes, this line is divided into three sections. The first is an open trench line of 9-ft. pipe, extending 800 ft. from the filtration plant to the gate-house at Lake Montebello. The second is in tunnel between the Lake Montebello and Lake Clifton gate-houses, a distance of 5400 ft., of which 4125 ft. is of 9-ft. pipe and 1240 ft. of 7-ft. pipe. This pipe is laid inside of a 12-ft. brick tunnel formerly connecting these reservoirs. The third section is in open trench between a shaft near Lake Clifton and the head of the distributing system.

The construction of this pipe line and method of manufacture of the pipe were described in the Engineering Record of Oct. 31, 1914, page 474. All of the pipe is of the standard Lock Joint design, made on the work by the Lock Joint Pipe Company, of New York, the contractor for the entire pipe-line construction. Six-foot lengths were used throughout on both diameters of pipe, the joints being grouted in the trench or tunnel. The pipe walls are 8 in. thick in the 7-ft. size and 9 in. thick in the 9-ft. size.

Before the regular manufacture and laying of pipe was undertaken a preliminary test was made at 35 lb. water pressure on two standard pieces of pipe joined together and bulkheaded at both ends. Evidences of leakage were very slight, there being only one point where there was an appreciable amount of flow. The existence of this latter minute leak was considered to be an allowable imperfection in practical construction, and the leakage limit of 38,000 gal. for the entire pipe line was hence computed from the measurements in this test.

The principal tests were made on the completed pipe line prior to backfilling the trench and closing the tunnel. For convenience in securing leakage observations these tests were made in two sections, one embracing the tunnel and upper trench line near the filters, and the other embracing the lower trench line.

The test of the first-named section included 4925 ft. of 9-ft. concrete pipe, 1250 ft. of 7-ft. concrete pipe, 60 ft. of steel specials, a 72-in. and a 48-in. gate valve and a steel distributor at the end, having seven foot-bends and seven 30-in. valves. It was possible to measure any leakage past the valves for correcting the total loss of water from the pipe line.

HOW LEAKAGE WAS MEASURED

This section was shut off by bulkheading a Y-end at Lake Clifton with a steel dished head and closing all of the above-mentioned valves. The pipe line was filled through a gate at the filter plant and the head was gradually built up to the maximum service level in the gate chamber, which brought on the full test pressure. This level was then maintained to compensate leakage by means of a hose line, and the rate of inflow was determined by taking measurements of about 20 sec. flow from the hose in a barrel periodically throughout the 24 hr. of the test. At the end of 24 hr. the total inflow through the hose was computed and the observed leakage at the various valves was deducted. The remainder represented the leakage in the pipe itself. It amounted to about 9500 gal. per 24 hr., out of an allowance for this section of 34,000 gal.

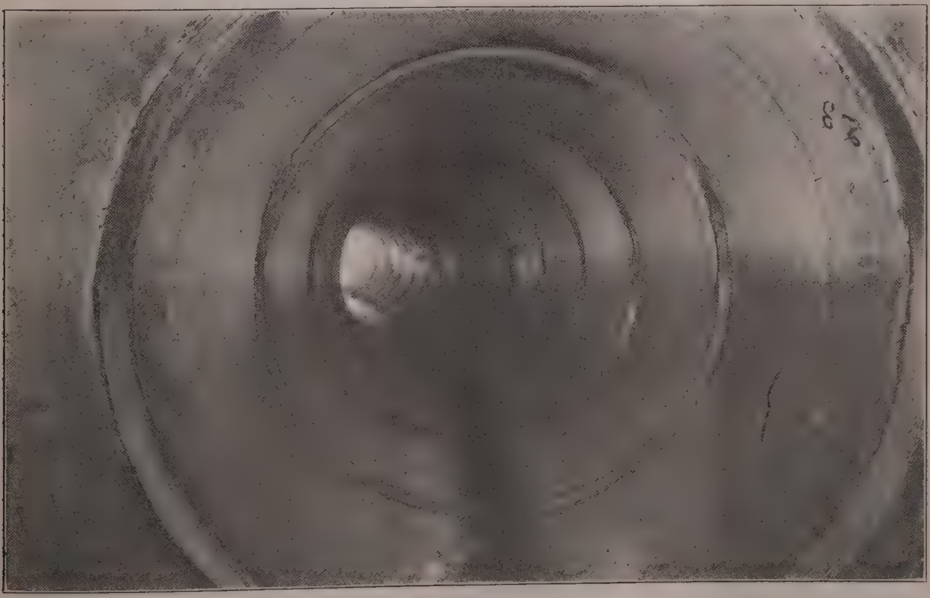
TRENCH WAS LEFT OPEN UNTIL HYDRAULIC TESTS WERE COMPLETED

Prior to the tests the contractors determined that when the tunnel was filled and then drained the water would leave the pipe bore quicker than it would flow out of the space between the outside of the pipe and the walls of the old 12-ft. brick tunnel. This would tend to produce a pressure from the outside of the pipe sufficient to cause an uplift 1700 lb. per linear foot. Since the tunnel is not backfilled, there would be nothing to prevent the rise of the pipe. To relieve this external pressure thirty-two 5 x 8-in. brass check valves were inserted in the 4000 ft. of 9-ft. pipe about 2 ft. below the center. These valves open inward upon the presence of external pressure and thus allow the water from between the walls to drain into the pipe. When the pipe is full and the pressure from the inside, the valves seat. In considering the leakage in the tunnel section above, it is very probable that a large amount passed through these valves, thus reducing to some extent the leakage attributable to the concrete.

BUILD UP HEAD FROM TOWER

The lower section of pipe line, embracing 1750 ft. of 7-ft. pipe in open trench, was shut off for test by bulkheading its lower end and closing a 48-in. valve leading into it from the tunnel. In order to get the desired head here a timber tower 48 ft. high was erected on high land at its upper end, so that a platform stood 70 ft. above the pipe. An open barrel on this platform, with ¾-in. gravity line leading into the concrete pipe, was employed to apply the head. A fixed water level was maintained in this barrel by means of an inlet tapped from the city mains. The city mains could not be used directly for test purposes due to wide local pressure fluctuations.

When ready for the test this section was filled from the tunnel through the 48-in. valve and the pressure was very gradually built up from the barrel on the tower, the rise in the small gravity pipe being carefully controlled by a globe valve and pres-



THIS CONCRETE PIPE, UNDER 35 POUNDS PRESSURE, ALLOWED A LEAKAGE OF ONLY 13,000 GALLONS IN 24 HOURS FOR A LENGTH OF 8000 FEET

THE HUGE SECTIONS OF MOLDED PIPE MEASURED 9 FEET IN DIAMETER

sure gage. Measurement of leakage was made by taking frequent observations on the flow which was necessary to maintain the level in the barrel. These observations were made in a second barrel. The leakage in this section proved to be 3500 gal. out of an allowable leakage of 4000 gal.

A part of the above tests was continued over 48 hr., and it was observed that the leakage decreased from the original rate of flow. This was attributed to the fact that much of the water taken by the pipe line in the first 24 hr. was absorbed by the dry concrete walls.

CHARACTER OF LEAKAGE

Throughout the tests careful examination was made of all portions of the pipe line which could be reached. In only a few cases appreciable amounts of leakage were found. In one there was a light spray measuring 4½ gal. in 24 hr. Another consisted of a dripping of 75 drops per minute. In not over half a dozen other cases was the leakage such as to give an accumulation of water sufficient for a flow, though there were evidences of dampness in spots. The moisture which appeared seemed to be about equal only to the evaporation.

The tests seemed to indicate that the mere dripping or flow of water from any particular portions of the pipe in sufficient quantity to be measurable was not an index of the actual amount of leakage. Apparently there was considerable loss even when the number of spots showing appreciable amounts of water was exceedingly small. It also appeared that a very much greater leakage than actually occurred, or was allowed, would not have been detrimental either to the pipe line or to other structures.

TIMBER TOWER WITH WATER BARREL ON TOP TO FURNISH TEST PRESSURE

The tests were conducted by the Lock Joint Pipe Company in conjunction with the Water Board of Baltimore.

How the Federal Evaluation of the Boston & Maine Railroad Is Being Done

F. C. Shepherd, Valuation Engineer, Outlines to Boston Society of Civil Engineers Work and Problems of Both Railroad and Government

ONE OF THE FIRST large railroads to be taken up for evaluation by the Government in accordance with the Valuation Act of March 1, 1913, was the Boston & Maine Railroad. The Division of Valuation began work on the system April 29, 1914, and the railroad began its part of the work several months earlier. How both the railroad and the Government are carrying out the work, and some of the problems encountered, are described by F. C. Shepherd, valuation engineer of the Boston & Maine Railroad, in a paper published on page 291 of the October *Journal* of the Boston Society of Civil Engineers, to be presented before the society Nov. 17. An idea of how the Government is handling its larger field squads is given in an article in the Engineering Record of Dec. 26, 1914, page 696. How the Boston & Maine by means of wash borings proved that ordinary cross-sections missed a large amount of fill that had settled into soft ground was set forth in an article in the issue of June 19, page 776. Other matters touched upon by Mr. Shepherd that have already been discussed are eliminated from the following notes taken from his paper:

FIRST STEP TAKEN IN NOVEMBER, 1913

The first start toward valuation work on the Boston & Maine Railroad was made in November, 1913, when the president appointed a valuation committee. We first started a careful study of the history of the railroad. The present system is composed of some one hundred and seventy original corporations, the first of which was chartered in 1796. Under reorganizations, purchases and consolidations, there are now forty existing corporations, all of which are either owned, leased or controlled by the Boston & Maine.

Having the corporate ownerships as now existing we next made a study for a schedule of inventory or valuation sections. We were confronted with the fact that the valuations are to be made by State lines, and that, for our own records at least, we should make the valuation sections agree with existing corporations. We have therefore made the valuation sections as a whole by corporate ownerships, although there are some parts where the ownerships were so extensive or diversified that we have given more than one section to a corporation. At the present time we have sixty valuation sections, for each of which separate inventories and collections will be made. With all these corporations there are six common carriers under the act, for which valuations will be made by the commission.

Jan. 16, 1914, we were advised that the Boston & Maine was one of the first roads on which valuation work would start, and that actual field work would be commenced about May 1.

Feb. 1, 1914, Government Order 1, specifications for maps and profiles, was issued, following which our valuation department was organized. We first made a careful study of what plans were in existence on our entire system so as to determine which of them could be made acceptable to the commission. A careful study revealed the fact that on our system of some 2500 miles there were in existence maps, of various sizes, and mostly on a 100-ft. scale, for about 1000 miles, which it appeared could be brought up to date without complete field surveys. For the other 1500 miles we found that complete new surveys would have to be made.

We started in the office making tracings, in accordance with the Government regulations, from the existing maps, and to complete these maps started small parties of two men each over our lines, obtaining the data necessary to complete the plans; such as survey station points for turnouts, structures, etc., locations and dimensions of culverts, fences and buildings and other miscellaneous items, all of which would have to be placed on the maps before they could be filed with the Government. For this work four parties of two men each, under the charge of an assistant engineer, completed the 1000 miles in the field between Feb. 16 and Dec. 11. As fast as the field work was done, the information obtained was placed on the tracings in the office.

SURVEYS FOR NEW MAPS FOR 1500 MILES

For the new survey work, parties were started in the field in February, 1914. A gradual increase in the number of parties was made until nine parties were at work, and have been continuously to date. Up to Sept. 1, 1915, these parties had completed resurveys for 1250 miles of line and an entire resurvey of the Boston terminal, and it is anticipated that the entire work will be done by Dec. 1, 1915. These parties are composed of four field men and one draftsman, three parties being under the direct charge of an assistant engineer. The field draftsman travels continuously with the survey party, and completes and forwards to the main office a plan which shows all existing features, survey stations, offsets and other information, or a complete detailed resurvey of our line. These plans are inked in on mounted paper in rolls containing approximately seven miles on a 100-ft. scale.

The speed of these parties varies with the character of the line on which they are working, there being some locations where on account of congestion, number of tracks, etc., they will not cover more than ½ mile a week, while on other lines, where the conditions are much different, we have had some parties cover 7 or 8 miles a week. The average throughout is approximately 3 miles for each party.

All these parties find their own subsistence, using for the most part passenger or freight trains to go back and forth. We have, however, in some instances, used motor cars, which have increased our work at least 2 miles a week, this condition, of course, applying to lines where the railroad stations are few and far apart.

DUPLICATE NOTEBOOKS

On this work we are using duplicate field notebooks, by which a carbon copy is obtained of all the work. By doing this the draftsman always has a copy of the field notes the day after they are taken. By keeping the field plans in close touch with the field survey work we reduce corrections and the picking up of omissions to a minimum.

As fast as the field plans are received in the main office they are laid out for the Government sheets and the tracings made. A draftsman in the office can complete such tracings at the rate of two to three a day. For all the tracings we purchase the cloth cut to size, with the border lines printed thereon. For the title work we are using a Golding printing press. In the press, instead of type, we are using plates which are reproductions of the lettering of one of our draftsmen. With the press and the plates we are able to put titles on our maps at a cost of about 1½ cents each, and at the rate of about 200 in four hours.

Where we have made resurveys we are painting the rail at every 100-ft. station, and noting the station at 500 or 1000-ft. intervals, this being done to aid in the taking of profiles where necessary, and also for the assistance of the Government engineers in their chaining. Up to the present time we have made no start on profile work. It is hoped that instead of the profiles, as called for in Order 1, we can substitute our regular track charts, which, while on a much larger scale, give a more comprehensive idea of the rise and fall of the grades, and which we think would be much more suitable for use in working out valuation than that called for by the map order.

LAND LINES THE MOST DIFFICULT PROBLEM

Our next step is the working up of the land lines and land records called for in Order 1, and it is this work which we find is the most difficult and takes the most time. At the start we found that there was practically no part of our system on which the land records were complete, and that there was a large proportion of our system on which no land maps were in existence. We have therefore found it necessary to reproduce on our plans all the land lines for the entire system. It can readily be seen what it means when it is realized that the purchase of the lands covers a period from about 1830 to date, and that there are about 25,000 land parcels to be located. Many of the original corporations are non-existent and have passed through so many hands during the different reorganizations that many records have been lost.

While our men in the office use the deeds which are in the possession of the railroad, many deeds are missing, and our land commissioner has for over a year had his assistants going to every registry point in New England and part of New York State obtaining the record of every deed in the name of any railroad which has ever been a part of our system. After checking this record against the deeds we have, abstracts are then made of the missing ones. Beyond this the commissioner is obtaining copies of all county commissioners' awards and all locations as filed for all the railroads. We find, even with all this information, that there are many places where we can get no records of ownership of parts of our right of way. At these points, of course, we will be obliged to fall back on the fact that the railroad is there and in possession. Such records will undoubtedly be accepted by the commission.

After making up the plans in accordance with Order 1 we are starting on Order 7, pertaining to schedules of land. For this order we are obliged to show on the form called for, besides the information above shown in the plan, the areas and the considerations shown in the deed for all the land parcels. These forms are then handed to the valuation accountant, who will work up the information regarding the original cost of every parcel. This means a tremendous amount of work, as it will entail going over all the original records which can be found and obtaining from these records information regarding every voucher by which payment was made for every parcel of land. Further than this, we are to find, and of course it is to our advantage also, any information possible regarding expense incurred in each acquisition. It will, of course, be absolutely impossible for us to find such information in many instances. Many of the old records are gone, or lost by fire.

FINDING HIDDEN ITEMS

The physical inventory is obtained from an actual survey of conditions as of to-day. It is perfectly obvious that many conditions which existed at the time the railroads were built cannot be shown or found to-day and that in such an inventory the railroads therefore would lose many items which should be used in the reproduction cost. This question has faced the railroads since they first started on this work. In order to reduce such a loss as much as possible we first issued a circular letter, asking for information regarding records not on file, or any specific data regarding difficulties met with during the construction of the various parts of the road, or any conditions which required unusual expense. The responses from this circular were gratifying. From it we have located many old records, plans and notebooks not known to be in existence. We have also received a great deal of information by letter.

To handle this feature of the work we organized a small squad for hidden research. It was the duty of some of the members of this squad to interview those from whom letters had been received, and finally we started some of them walking the line, interviewing everybody who had any knowledge of any part of the railroad. All the information which was obtained was placed on index cards. Moreover, all the notebooks and plans that we could find were collected. In addition to this the valuation accountant has had a squad of men at work getting for us all information regarding quantities on the many large improvements and grade-crossing separations made since the railroad was originally constructed. All the information so obtained is furnished to the pilots for their use as they go over the various parts of our system.

To assist in describing the inventory features, I have divided them into three departments: Engineering, lands and accounts.

HOW THE GOVERNMENT PARTIES PROCEED

The first Government track and roadway party started on the Boston & Maine Railroad April 29, 1914. Other parties were added, so that during the year 1914 there were five such parties at work. The work here was suspended during the winter months and these parties transferred to the South. They returned here again in April, and during this year six parties have been at work. Up to the present time, 1900 miles have been covered by these parties, and it is anticipated that all the track and roadway inventory work will be completed on the Boston & Maine by Dec. 15.

All these parties are under the charge of a senior field engineer, with headquarters in Boston. Each party is under the charge of an assistant engineer. These parties usually comprise nine men: the assistant engineer, three cross-sectionmen, three recorders and two computers.

The cross-sections are plotted directly into notebooks in the field, and usually on a 10-ft. scale. On each section is shown the distance out and the distance down, with the center of the track and the base of the rail being assumed as zero; for all changes in the section the original ground surface at the base of fills or edge of cuts is noted. The original surface where removed is plotted by judgment. No elevations are taken. When the sections are being made, the classification is shown on them.

THE MASS PROFILE

Each day the cross-section notes are turned over to a computer, who works up the area of each section by use of a planimeter, and transfers the areas to a quantity diagram. This, in reality, is a mass profile, from which the quantities of each cut and fill can be obtained directly by planimeter. The diagrams when finished are sent to Washington, where they will be used in connection with the necessary computations for overhaul. Ballast depths and sections are taken for each cut or fill and deducted or added to the cross-sections, depending on whether the cross-section is an embankment or a cut. Ballast depths are found by digging, and for this the railroad furnishes the labor.

The recording party chains the line and makes a complete inventory of features other than grading and ballast. The weights of the rails are noted; the ties, rail braces, tieplates and anti-creepers are counted in two 600-ft. blocks for each mile, from which an average is obtained for the entire mile; all culverts are measured and dimensions noted; all information at turnouts is obtained, with a notation for each part, such as the switch, frog, guard rail, etc.; a record is made of all signs and fences; bridges up to 16-ft. span are inventoried; the result being a complete inventory of all the parts which go to make up the track and roadway, outside of ballast and grading. All computations and collections of this information are made in the office by a computer, and for each mile or track plan as made by us. The computers in the office collect all this by accounts and work up all quantities.

When the work was first started the ordinary type of notebook was used, with a complete running sketch being made of the entire road, and from this the computations were made. As the work proceeded, however, developments were made of a type system, by which the various items are typed by letter or number. With the aid of these and special field forms, much better progress is made and a much better inventory obtained. At the present time these field parties average about 2½ miles a week.

INVENTORYING BRIDGES AND BUILDINGS

The work in connection with inventory of bridges and buildings was started in October, 1914. For these parties both the Government and the railroad furnish one engineer and one computer. Our representative is furnished with copies of all the bridge or building plans which we can find in our files and also information regarding the construction, weights of superstructures and specifications if necessary. The bridge party visit in turn every bridge of over 16-ft. span as they travel along the line, and take sufficient measurements to identify the plans or records, which they may have or to compute all quantities in case no plans or quantities are in existence.

The building party performs the same work in connection with buildings. For the buildings sufficient measurements are taken so that the cubical contents of each building can be figured, and sufficient notations are made as to the kind of construction of the building as will be necessary in making an appraisal of the building. In the buildings, records are taken of all furniture and fittings other than stationery. The line between the building and the track and roadway party is usually drawn at the building wall, although the building party do take the platforms and awnings, drains directly connected with the building, and in some instances have taken the features outside the building, such as driveways, shrubbery, etc. For our own records we are also taking photographs of each building. Up to the present time these parties have covered some 800 miles, and hope to finish our line some time during the winter. In order to make more speed, we have furnished a motor car for the use of the bridge and building party as it travels over the line. We have recently, also, put on an additional building party which is taking the buildings at the large junction points or terminals.

SIGNALS AND INTERLOCKING

The signal and interlocking party started late in October, 1914. In the party there are two representatives from the Division of Valuation and a pilot from the railroad. This party is taking all measurements necessary for the working up of the various quantities for all automatic signals, crossing and warning signs and interlocking towers. This party has completed some 700 miles to date, and will undoubtedly finish during the winter.

In all this work no attempt has been made toward fixing the depreciation, although this has been done in some of the other districts. The Government engineers are, however, making careful notations regarding the condition of the various parts as they find them, and on the bridges and buildings have made some attempt toward fixing the service life which can be expected from the various parts of the structures. It is anticipated that the depreciation, or the condition percentage, will only be obtained after a careful study of all maintenance records and operating conditions, and by traveling over the lines with a special train with the proper representatives of the railroad and the Division of Valuation.

LANDS

The land work for this district is under the direct charge of the valuation attorney. For the actual field work he is being aided by assistant attorneys and by senior and junior appraisers.

As fast as we finish the land maps for a valuation section, prints are turned over to the valuation attorney. In June, 1914, actual field work was started on the land valuation. The first work in the field is the establishment of zones, each zone depending on the character of the adjacent and adjoining lands. In some places the zones are continuous, where the character of the land is similar on both sides of the right-of-way, but where there is a distinct difference on either side, the zones are sometimes carried along the center of our right-of-way. These zones are established by actual inspection of the line.

The appraiser next visits the assessors' offices in the district where the railroad is located, and obtains from their records the assessed values of all the adjoining or adjacent lands, noting the comparison between the assessed and the actual values. He then obtains records of all bona fide sales in the locality which can be substantiated, and finally visits representative men, usually real-estate men, in the various localities, and obtains from them their opinions of the actual value of these adjoining and adjacent lands.

TREATMENT OF LAND INVENTORY YET TO BE DETERMINED

From all these data the appraiser makes his estimate of the normal market value of the adjacent and adjoining lands, which is the so-called basic value to be used in the valuation of our right-of-way lands. What the next procedure will be has not yet been determined by the Division of Valuation.

The railroad land committees have had this question under consideration for a long while. They have asked from all the roads any information which can be given on recent acquisitions, divided so that it would show what the railroads have to pay above the normal market value for consequential or sequence damages, and also the acquisition costs. This information will be compiled and filed with the Division of Valuation so as to give to them a record of what might be expected in the acquisition of new railroad lines, and information which the railroads think should be used in the fixing of the values of the rights-of-way as now owned.

It is ordinarily estimated that the land values of a railroad represent about 30 per cent of its value. This would mean approximately a $5,000,000,000 investment for lands by the railroads of the United States.

The Boston & Maine, through its land commissioner, has its own representatives at work compiling basic values for use in checking the Government figures. Up to the present time there has been no real co-operation between the Division of Valuation and the railroads on land values. Various schemes have been proposed by the railroads for such co-operation, and the director himself has expressed himself very strongly in favor of some method of co-operation, but has stated that it is his opinion that the opinions obtained from local parties should be found separately.

The accounting work for this district is under the direct charge of a district accountant. The work here is being handled by an accountant, who has under him a number of assistants. The first accounting work in connection with valuation of the Boston & Maine was started by the Government in May, 1914. An attempt was first made to work out the original cost to date of the original Boston & Maine corporation. This corporation was chartered and construction work started in 1835. The accountants were given all books or records which we had in our possession and started to make up the original cost to date, using the present classification and accounting system. After considerable time had been spent on this work the accountants came to the conclusion that from the records available they would not be able to make up in any way such an original cost. This work was then dropped.

Since that time they have been at work on the financial history of the Boston & Maine Railroad. They have attempted to work up full details of all stock and bond issues, and also to show where all the moneys coming from such issues have been used. They have also made a careful investigation of all operating accounts, endeavoring here to work up a complete statement of all the operating earnings and where all these earnings have been used, as, for instance, operating expenses, additions and betterments, retirements, dividends, etc. It is estimated that up to the present time they have completed perhaps one-half of the work which they are to do.

This briefly represents the present condition of the valuation work on the Boston & Maine Railroad, and is fairly typical of the work which has been started on various other roads in the United States. On some of these roads the inventory of the physical property has been completed, and in one or two instances preliminary reports have been made on these roads, showing the cost of reproduction new and the cost of reproduction less depreciation. In these reports, however, no values were placed on the lands or on any of the contingent items, but just the mere inventory of physical property.

COST AND ACCURACY OF WORK

The cost of this work, both to the Government and to the railroads themselves, has been widely discussed. The work on the Boston & Maine will consume over two years, possibly three, during which time a maximum organization of 130 will have been actively at work. We estimate that the cost to the railroad will be at least $100 per mile and probably more, and that the cost to the Government will be at least an equal sum. The cost on other roads will vary, depending upon the conditions, some more and some less, but it is anticipated that at least $100 per mile will be expended by all the railroads in the country, and that the Government will probably spend a similar amount. This will make the total cost of valuation approximately $50,000,000.

Many questions have been asked as to the accuracy of the inventory of the physical property. We have always found that the Government engineers are anxious to arrive at as correct results as can be obtained, and it is probable that the errors in the parts that can be readily seen will be small. In the grading and masonry, however, there are many chances for loss. No one knows how thick or how deep many of the masonry walls or abutments are, or what may be under them. For the grading, the original surface of the ground is always a matter of guess. A comparative test was made last year by the Delaware & Hudson Company, on the cross-sectioning of a part of their line. One party made cross-sections, using first the Lock level, second the "Y" level, and third using a transit and level. It was found that the same party doing the cross-section work by these various methods obtained practically uniform results, but that when a second party did the work, using the same methods, their results were uniformly alike, but differed from the results obtained by the first party. In other words, the mere personal element shows much variation in results obtained. It is then evident that with all the care that can be taken, there is liable to be a considerable loss to the railroads on some items, such as grading and masonry.

Test Plant Operated to Deodorize Oil Refinery Wastes

Aeration, Coagulation, Sedimentation and Storage Tried at Installation in Neodesha, Kansas, to Prevent Stream Pollution

By F. R. HESSER
Assistant Engineer, Kansas State Board of Health

AERATION, coagulation, sedimentation and storage were the methods tried in an experimental plant to deodorize the wastes from the Standard Oil Company's refinery at Neodesha, Kan. The wastes, amounting to 1,000,000 gal. daily, were discharged into the Fall River near its junction with the Verdigris River. Cherryvale, Independence and Coffeyville each supplied with an up-to-date mechanical filtration plant, take their water from the Verdigris at distances of 8, 11 and 30 miles respectively from Neodesha. After a very dry fall these towns in January, 1915, began to complain of odors and tastes in their water, and the State Board of Health was requested to seek a remedy.

Investigation led to the belief that, due to the unusual condition of the streams, the refinery waste was the source of a large part of the offensive odors. In order to avoid the recurrence of such conditions it was desirable to find a practicable method of deodorizing the waste before discharging it into the streams. While the Standard Oil Company had nothing to offer in the way of solution, it agreed to construct an experimental plant, to be designed and operated by a representative of the State Board of Health.

ODORS DUE TO ACIDS

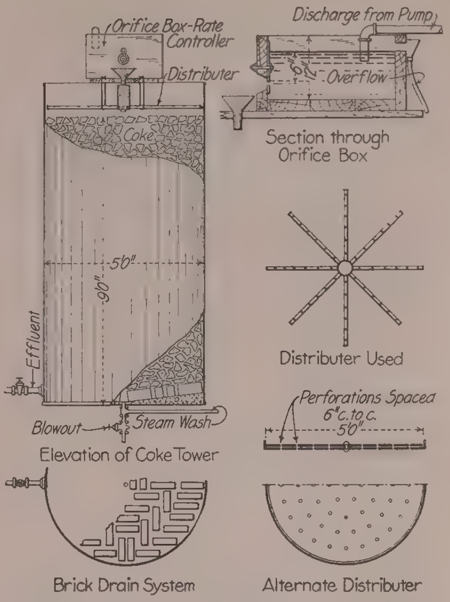
Preliminary experimental work led us to believe that the odors were due to compounds of naphthalenic and sulphonic acids, partially in solution and partially suspended as an emulsion, in the wash water from the agitators. The writer, therefore, designed a plant which, it was thought, would break up the emulsion and remove odors by aeration. The original plan included a rate regulator, coke aerator and steam wash for regenerating the coke, and contemplated pumping waste water from some point in the outfall sewer. Since the odor complained of is characteristic of the agitator wash water it was found advisable to place the plant near the agitators and thus avoid pumping. Chemical dosing devices and a settling basin were added later during the three weeks' operation, concluded April 10, 1915.

DETAILS OF PLANT

The coke tower, 10 ft. in height and 5 ft. in diameter, was made of two sheets of ⅜-in. steel, lapped and riveted along the horizontal and vertical seams. A flat circular bottom of the same material was placed in the cylinder and tapped at the center to receive a 1-in. bushing. The cylinder was then erected vertically upon timber supports so that its base was about 6 in. above the ground. A 1-in. steam line, tapped into the steam main between agitators 1 and 2, was connected to the bottom bushed tap by a tee and nipple and a valve placed on the open or down end of the tee to serve as a drain or cleanout valve. Valves were placed in the steam line at the main and just outside the cylinder. The main valve was closed at night during cold weather to prevent excessive condensation and ultimate freezing in the 1-in. line.

A layer of concrete 3 in. thick at the outside and sloping to 1 in. thick at center was then placed on the cylinder bottom and a 1½-in. effluent line was tapped into the north side of the cylinder just above the concrete floor. A hand-operated valve just outside the cylinder controlled the flow of effluent through this pipe, which extended about 8 ft. and dropped through an elbow and 6 in. of nipple into the sewer catch-basin serving agitator 3. Brick were then placed on edge and staggered to form a gridiron collecting system and support for the coke.

ARRANGEMENT OF EXPERIMENTAL DEODORIZING APPARATUS AT NEODESHA, KANSAS



AERATION AND COKE STRAINING DEVICE FOR DEODORIZING OIL REFINERY WASTES

Hard coke was placed in the tower to a depth of about 9 ft. above the bottom, with no attempt made to grade it by size. The pieces ranged in size from 1 or 2 cu. in. to 50 cu. in., with at least 80 per cent between 10 and 30 cu. in. It later became apparent that a small section on the southwest side of the tower had been packed too hard, for when steam was passed through the tower the whole exterior became evenly heated with the exception of a section about 2 ft. wide extending from the top to about 5 ft. above the bottom.

RATE REGULATOR

The rate regulator consisted of a 2 by 2-ft. wooden box, 1 ft. deep, having pivoted inside one face a steel orifice plate 10 in. in diameter and ¼ in. thick. Six orifices of different sizes were so spaced about the center of the plate that any one could be made to discharge through a beveled opening near the bottom of the box. A constant head of 6 in. was maintained over the discharging orifice by means of influent valves and a 1½-in. overflow in the back face of the box.

The orifice diameters and corresponding rates are as follows:

Diameter of orifice, in.	Discharge gal. per hr.	Rate mil. gal. per acre per day
¼	0.57	1.82
½	2.19	7.00
¾	4.9	15.70
1	8.8	28.0
1¼	13.6	43.6
1½	19.6	62.7

The orifice box, for plain aeration, is supported upon two 2-in. planks laid across the top of the tower. One of these planks, crossing the middle of the tower, is perforated by a 4-in. hole directly over the center of the tower and supports the distributer.

The distribution system consists of a section of 6-in. steel pipe, 10 in. long, plugged at the lower end and having eight ¾-in. taps spaced equidistantly around the circumference and about 1 in. above the bottom. Into these taps are screwed eight ¾-in. pipes, 26 in. long, capped at the outer end and perforated with six 3/16-in. holes along the upper side. This sprinkler is wired directly under the hole in the plank previously mentioned, so that the discharge from the orifice box falls into the 6-in. pipe and is discharged into the air above the coke surface.

During the first two days raw water was obtained from a 1½-in. pipe tapped into the wash-water discharge line from agitator 3. The waste varies, however, from strongly acid at the beginning of wash to an alkalinity approaching that of raw river water at the end of wash. The odor also decreases and the period of operation was limited to that of washing (about 4½ hr. maximum per batch of oil).

To obtain a uniform wash for treatment agitator 1 was connected to agitator 3 and used as an equalizing basin, proportional quantities from various washes being mixed and stored there. A 1½-in. supply pipe connected, as in the case of agitator 3, conveyed the raw waste to the orifice box.

CHEMICAL DOSING

After one week's run on plain aeration a sedimentation basin was erected between the coke tower and agitator 3. It was a covered, steel tank, 8 ft. in diameter and 5 ft. deep, placed on wooden bents so that an outlet pipe 7 in. below the top would discharge into the distributer.

The orifice box was made to discharge into a mixing trough of white pine 3 in. x 3 in. by 5 ft. long, having baffles and bottom cleats to cause agitation. Solutions of lime, iron sulphate, alum or colloidal clay were mixed to known strength in 16-gal. kegs provided with brass spigots. These discharged into tin cans in which a 6-in. head was maintained above a 1/16-in. orifice near the bottom, which, in turn, discharged into the orifice box or the mixing trough. The basin was provided with underflow baffle at the inlet end and skimming weir at the outlet end.

RESULTS OF OPERATION

Samples were collected and diluted until the characteristic odor was masked. The results were then recorded by the dilution strength. Raw waste was usually detected in 1 to 1000 or 1 to 4000 dilutions. By aeration, at rates of 28,000,000 gal. per acre per day or less, an effluent masked in 1 to 256 dilutions could be obtained. By coagulation with lime and iron and subsequent aeration equal or better results were obtained, and plain storage for periods of 24 hr. or more effected a reduction of 25 per cent in some cases. Dilutions of 1 to 256 represent a reduction of odor of 75 per cent or more. This will be masked by the minimum mean flow of the Verdigris River, when the agitator waste is at its maximum of about 400,000 gal. per day. Further experimental work will be carried out soon to obtain data upon which to design a plant and base its operation.

THIRTY-MILLION PASSENGERS were carried on ferry boats in San Francisco bay without injury through accident during the year ending June 30, 1915. In the last 25 years, it is stated, only two deaths have resulted from ferry mishaps.

Further Means Suggested for Interpretation of Water-Turbine Test Data

Diagrams Recently Explained in Engineering Record Should Be Supplemented by Other Features, and Computations Simplified by Special Computer

By L. F. HARZA
Consulting Engineer, Portland, Ore.

THE TWO recent contributions of Prof. S. J. Zowski upon "Some Recent Tests of High-Power High-Speed Water Turbines" in the issues of the Engineering Record of Nov. 28, 1914, page 585, and Dec. 26, 1914, page 689, are devoted to a discussion of the latest phenomenal developments in the design of high-characteristic turbines. The methods there used for the analysis of test data and for representing graphically the operating characteristics of the turbines were described by a subsequent article in the issue of Jan. 9, 1915, page 45, by George H. Bancroft. It is with regard to these methods that I desire to offer a word of comment and some additional material without which in my judgment the series of articles is incomplete. The writer has used for several years the method of turbine analysis advocated by Mr. Bancroft with some modifications and additions, part of which he described in a discussion of a paper by O. B. Coldwell upon "Principles to Be Considered in Selecting a Waterwheel Unit," published in the *Proceedings* of the American Institute of Electrical Engineers of December, 1912. This paper with its discussions was not published in the *Transactions* and is for this reason not conveniently available, which fact I offer as an excuse for again mentioning some of the methods there presented.

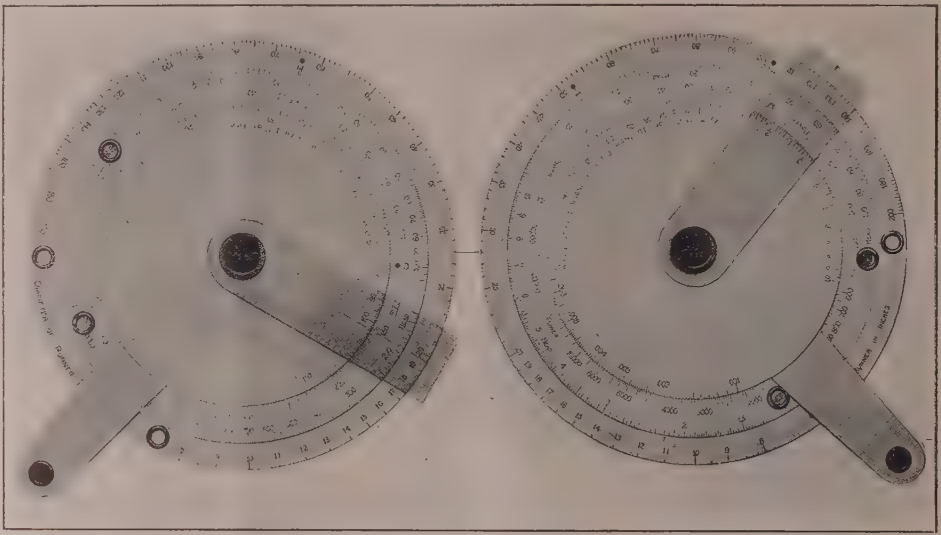


FIG. 1—THIS SPECIAL COMPUTER HAS PROVED TO BE A GREAT TIME SAVER

Graphical representation of the test data of a turbine by "equal-efficiency curves" is chiefly useful in presenting to the mind's eye its characteristics in the form of a picture, from which by practice can be judged its relative suitability for different classes of service as compared with some other turbine. To study a turbine without these curves is comparable in difficulty and laboriousness to the task of reading a book if each letter of each word were on a different page so that neither the letters of a word nor the words of a sentence could be viewed collectively; it is worse than trying to picture in the mind the topography of an area by viewing a map showing the elevations of isolated points but without contours.

FIVE NEW FEATURES TO HELP VISUALIZE TURBINE CHARACTERISTICS

The writer adds to the system of platting as used and described in the previous articles five additional features believed to add to the clearness of the mental picture, namely: (a) The reduction of the test data of turbines of all sizes to some uniform size; (b) the use of a uniform size of platting sheet with identical scales, at least for all turbines of the same general class, such as those described by Professor Zowski; (c) the provision upon this platting paper of permanent background curves of equal values of the "specific speed" or "type characteristic" in addition to the vertical and horizontal platting lines; (d) the platting of an additional form of diagram not previously described; (e) the use of special mechanical means to reduce the data to form for platting.

In Professor Zowski's first contribution he shows characteristic curves of seven turbines, one of 28-in., one of 35-in. and five of 30-in. size, and in his second contribution he discusses one of 35-in. and one of 30-in. size. The advantage of reduction to a standard size for platting should be obvious if it can be done without too much work, except in cases where it is proposed to use the same size as tested. The uniform size of platting sheet with its uniform scales is of importance, as it permits the making up of a Van Dyke negative from which these sheets, containing also the curves of "specific speed," can be readily duplicated; and comparison of turbines is made more apparent to the eye.

SPECIAL COMPUTER

The reason why the reduction to uniform size of runner is not more generally practised is probably the necessary additional work of computation. About four years ago the writer constructed a circular computer (shown in Fig. 1) for facilitating these computations, and this has proved a great time saver in his own work. The size of turbine to which this computer was intended to reduce all data is 10 in., and the standard head is 1 ft., the latter being the same standard head as used by the previous writers. The calculator could, of course, be made straight as well as circular.

The formulas solved by the computer are

$$N_1 = DN/10\sqrt{H} \qquad (1)$$

and

$$P_1 = 100P/D^2H^{3/2} \qquad (2)$$

in which D = turbine diameter in inches; H, head in feet during test; P, brake horsepower under head H; N, revolutions per minute under head H; P_1, power of a 10-in. runner under 1-ft. head corresponding to a power of P under head H, and turbine diameter D; N_1, revolutions per minute of a 10-in. runner under 1-ft. head corresponding to a speed of N under head H, and turbine diameter D.

These formulas are the same as given by Bancroft, with the additional factors for reduction to a 10-in. diameter. This size was chosen as a convenient one mathematically. Since that time the manufacturers have been gradually approaching 30 in. as a standard size of runner for experimental test purposes. The addition of another scale on the baseboard (not shown) would permit the reduction of data from any tested size to any other desired size, such as 30 in., equally well. Another scale might also be easily provided such that the computation would not need to be reduced to a 1-ft. head, but could be applied directly to the proposed operating head if desired. The formulas solved would then be

$$P_1 = \frac{d^2h^{3/2}}{D^2H^{3/2}}P \qquad (3)$$

and

$$N_1 = \frac{D\sqrt{h}}{d\sqrt{H}}N \qquad (4)$$

in which d is the desired size and h the desired head.

DESCRIPTION OF COMPUTER

It will be seen from Fig. 1 that each set consists of three disks. The upper one is fixed by means of an extension arm to the baseboard, and is provided with the scale of P_1 in the left set and of N_1 in the right set. The largest disk has an outer scale of turbine diameter D for each set. The intermediate disk has an outer scale of head H for each set, with inner scales of power P for the left set and speed N for the right set.

By way of illustrating the use of the computer assume the data as given by Professor Zowski for No. 1796, in the test of which it was found that a 28-in. wheel under a head of 17.11 ft. and running at a speed of 153 r.p.m. gave 125.2 hp. with an efficiency of 66.52 per cent. To reduce to a 10-in. runner, the diameter of the tested runner, 28 in., on the largest disk of each set is placed opposite the graduation between the two sets (on the line joining their centers) on the baseboard. The head at time of test, 17.11 ft., on the outer scale of the middle disk of each set, is then placed opposite the graduation H on the largest disk. From the left set the value of P_1 is then read on the upper disk opposite the tested value of P, 125.2 hp., on the inner scale of the middle disk; and the value of N_1 on the right set of disks is read on the uppermost disk opposite the tested speed, 153 r.p.m., on the inner scale of the middle disk.

It will be noted that after the largest disk is set no further computation is involved with reference to the tested or desired size of turbines; it is as easy to reduce all test data to the same size as not to do so. If the head during test were constant the middle disks also would not need to be moved; in reality they must be shifted slightly for each observation to involve the fluctuations in the test head at Holyoke. The computations thus consist principally in reading P_1 and N_1 opposite P and N for each observation of the test, a very simple and rapid process comparable to multiplying each of a series of numbers on the slide rule with the same multiplier. The process would be equally simple if additional scales were added to reduce to any desired size other than 10 in. and to any desired head other than 1 ft.

VALUE OF UNIFORM SCALES

The value of uniform size of turbine and scale of platting is illustrated by the three accompanying figures, representing three successive types in point of their power output for a given speed. Fig. 3 is test No. 1796, the same as Fig. 1 of Professor Zow-

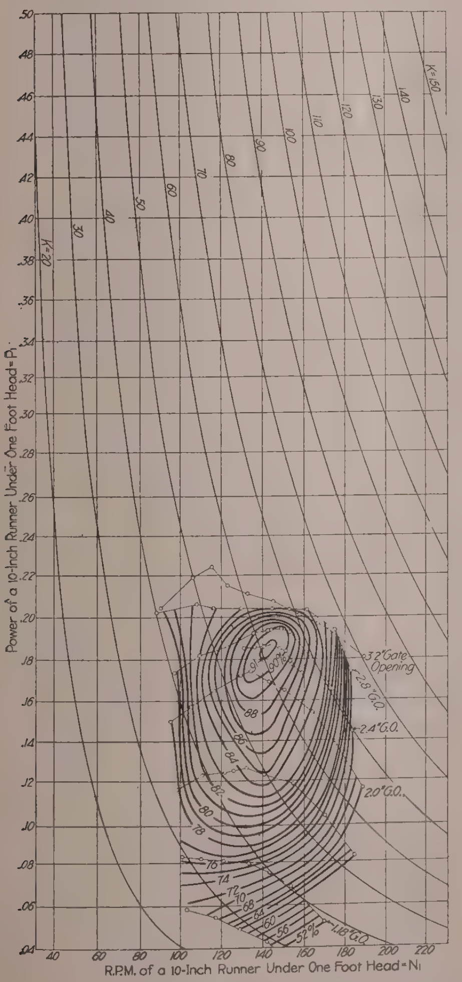


Fig. 2—Test 2321

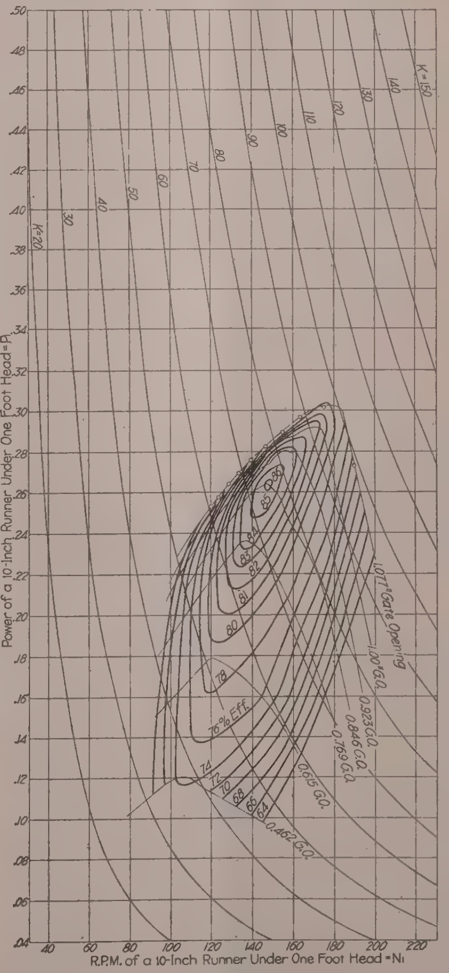


Fig. 3—Test 1796

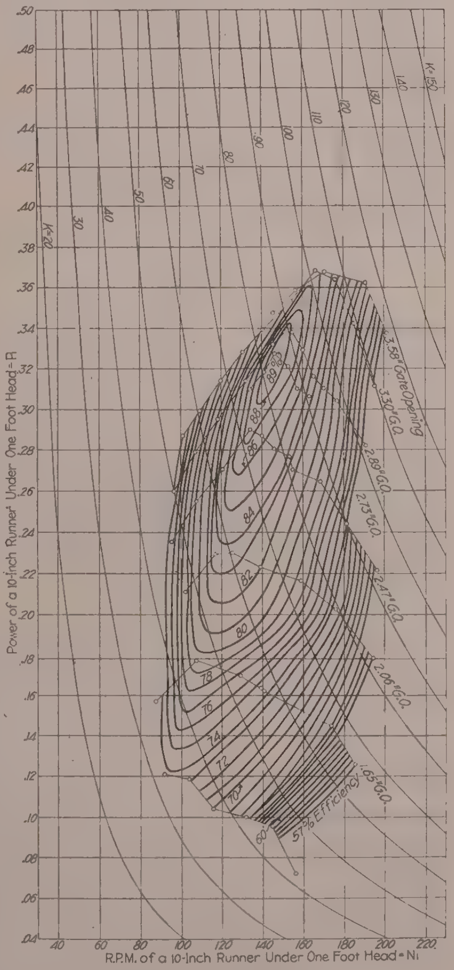


Fig. 4—Test 2270

THE VALUE OF UNIFORM SIZE OF TURBINE AND SCALE OF PLATTING IS SHOWN BY THESE THREE FIGURES, REPRESENTING THREE SUCCESSIVE TYPES IN POINT OF THEIR POWER OUTPUT FOR A GIVEN SPEED ski; Figs. 2 and 4 are Nos. 2321 and 2270 respectively, which are mentioned by him at the close of his first article. The height of diagram here shown is just a trifle more than sufficient to permit the platting of Zowski's runner No. 2363, which indicates its remarkable increase of power above that of test No. 2270, which represented approximately the existing limit prior to the recent Zowski runners.

There are added to the usual background lines, in all of these diagrams, lines of equal values of "specific speed" or "turbine characteristic" K or

$$K = (N\sqrt{P})/H^{5/4} \qquad (5)$$

The relation between K, P_1 and N_1 for platting these curved background lines, and using the general size of reduced turbine of d instead of 10 in. and the general head of h instead of 1 ft., is derived as follows: From equations 3 and 4

$$P_1N_1^2 = \frac{PN^2h^{5/2}}{H^{5/2}} = K^2h^{5/2} \qquad (6)$$

from which

$$K = N_1\sqrt{P_1} \div h^{5/4} \qquad (7)$$

If h is 1 ft., as is usual, then

$$K = N_1\sqrt{P_1} \qquad (8)$$

Also, $h^{5/4}$ will be constant for any head to which the test is reduced and will therefore permit the platting of curves of equal values of K, which are hyperbolas between N_1 and P_1. These curves are permanently inked upon the negatives from which the platting sheets are printed so that no extra work is thereby added to the work of platting. Thus it will be seen by interpolation that the three turbines at their points of best efficiency have specific speeds of about 63, 76 and 85 respectively.

New Form of Diagram

In Fig. 5 is shown another and very useful form of diagram, used by the writer for several years but not heretofore published. Its chief use is in the operation of the station after the generating units have been installed, although it also constitutes a valuable guide to the selection of a unit, as in the case of the other diagrams. After installation the speed of any unit is fixed by the generator, whereas the head may vary. The horizontal scale, therefore, shows a varying head with a fixed speed and is obtained from the horizontal scale N_1 of the preceding type of diagram, which shows a varying speed with fixed head, by means of equation 4 after substituting $h = 1$ ft., $d = 10$ in., $N =$ chosen constant speed of unit, and $D =$ chosen size of runner, thereby obtaining

$$N_1 = DN/d\sqrt{H} = \text{constant}/\sqrt{H} \qquad (9)$$

Thus, if it is required to plat the operating curves of a No. 1796 runner of 60-in. size to operate at a speed of 120 r.p.m., we have

$$N_1 = 60 \times 120/10\sqrt{H} = 720/\sqrt{H}$$

from which the values of N_1 for the distorted horizontal scale of H shown at the top of test No. 1796, (Fig. 3) were computed. Now draw vertical lines through these values of H intersecting the equal-efficiency curves below; tabulate the values of P_1 at which these lines intersect the various curves; and then in an adjoining column compute and tabulate the products of these values of P_1 by the value of $D^2H^{3/2}/100$ for the vertical line in question. These products will be the ordinates, and the values of H the abscissas, for platting the curves of Fig. 5. This diagram may also be platted from the curves of Bancroft's Fig. 1 by drawing vertical lines for each value of H and proceeding as above.

Best Way to Plat

The most accurate way, however, to plat this diagram is to proceed independently of any other forms of diagrams which may have been platted, by computing from the original test data the abscissa and ordinate of each observation included in the test. To derive the formulas for this computation, solve equation 4 for h, the abscissa, obtaining

$$h = \frac{N_1^2d^2}{D^2} \cdot \frac{H}{N^2} \qquad (10)$$

Now N_1 is the constant speed at which it is proposed to run the desired turbine, while d is its diameter, and D the diameter of the tested turbine. Hence the first factor is constant throughout the test; the test head H and the test speed N alone vary for each observation, and the former but slightly. After first computing and tabulating the values of the abscissa h from equation 10 for each observation of the test, substitute this with the other elements, all of which are known, in equation 3 to obtain the ordinate p for platting.

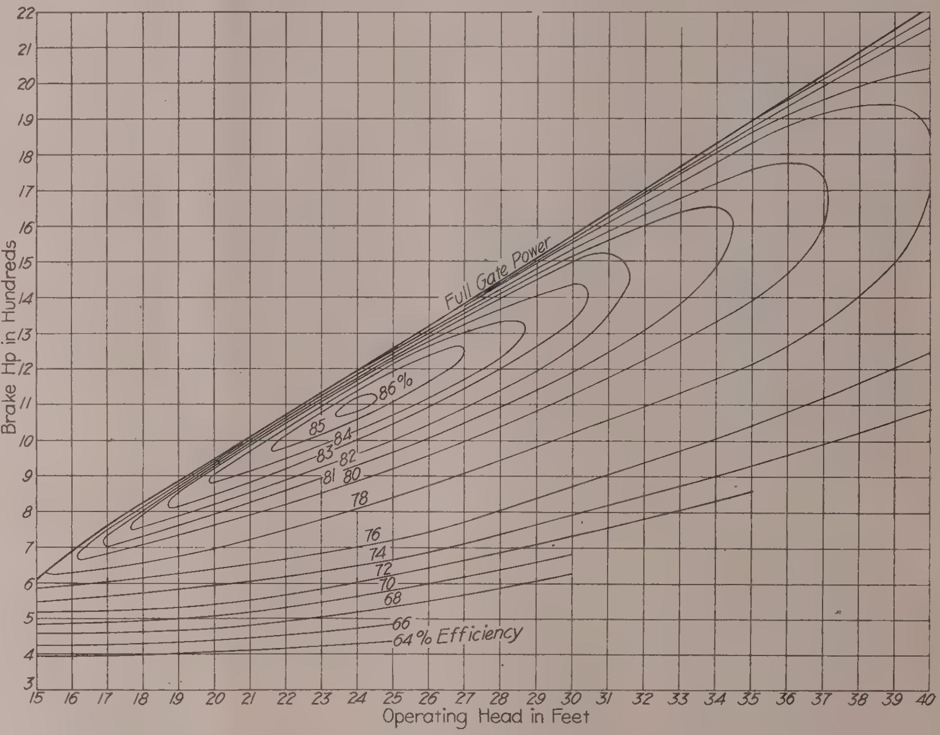


FIG. 5—THIS NEW FORM OF DIAGRAM IS USEFUL IN OPERATION OF STATION

As an alternative a formula can be derived such that the ordinate p can also be obtained directly from the test data without first computing h; thus by substituting h from equation 10 in equation 3 we have

$$P_1 = p = \frac{d^5}{D^5} \cdot \frac{N_1^3}{N^3} P \qquad (11)$$

It is doubtless more convenient, however, to compute h first for each observation and then use these values in equation 3 for obtaining p as explained above.

The points may then be platted directly in Fig. 5, using the co-ordinates h and p, and writing the efficiency beside each point, then interpolating lines of equal efficiency between them; or, preferably, a diagram very similar to Bancroft's Fig. 1 may first be platted, except having h and p for coordinates instead of N_1 and P_1 for the lower set of curves. This diagram may then be used to plat Fig. 5, as explained by Bancroft for his very similar problem, thus insuring greater accuracy than by interpolating the equal-efficiency lines.

Possible Applications of Diagram

This diagram, Fig. 5, now visualizes the operation of the turbine by showing the efficiency resulting from operation at any actual specified power and head. It is equally easy to adjust the vertical scale to kilowatts at the switchboard and to place such a diagram where it will be at all times before the operator, so that he will know the economy with which his units are working and whether to increase or decrease the number of units in service to improve his economy. It is also very useful in converting switchboard and head readings to river discharge in the frequent instances where a record of stream flow is derived from the station operating data.

All computations in connection with the reduction of test data for platting any of these forms of characteristic curves, as well as for applying these curves to the selection of turbines for any given conditions, can be made by means of the "computer" in a very simple and rapid manner. But few hydraulic engineers are accustomed to making such graphical studies in selecting equipment, the excuse usually being that such detailed studies are properly confined only to the manufacturer of turbines. On the contrary, these characteristic curves are only the pictures of the results accomplished by the far more elaborate study of the designer, and are chiefly of use to the prospective purchaser, just as an architect's sketch indicates to the client in a general way what type of building he is to get and whether it will be acceptable in appearance.

Two Million Miles of Dirt Roads, the Department of Public Roads estimates, have been built in the United States. The total length of public roads of all kinds in this country is estimated at 2,250,000 miles.

FOREST PARK ENTRANCE HAS 40-FOOT CONCRETE ROADWAYS AND 25-FOOT PARK SPACES

Test Results Will Form Basis for Selecting Pavements in St. Louis

Nelson Cunliff, Commissioner of Parks, Tells Missouri Highway Engineers of His Experiments with Many Types of Surfacing

REINFORCED and plain concrete with various mixes and materials and a number of bituminous macadam types using Rocmac, Stanolind, Tarvia and Texaco are used in the experimental stretches of road laid by the Department of Parks of St. Louis, Mo., in an effort to obtain a satisfactory pavement. The following information has been abstracted from a paper presented at the recent convention of the Missouri Highway Engineers' Association by Nelson Cunliff, commissioner of parks:

Until 1910 St. Louis park drives paved with 6 to 8 in. of gravel proved satisfactory. With the increase in the use of the automobile these drives produced a great deal of dust and started to deteriorate. In order to overcome this the gravel was given a treatment of oil primarily as a dust preventive, and with the additional hope that the oil might have some binding quality that would maintain the road surface. The oil performed its function well for a few years; then the surface of the road began to show a great number of bumps, which proved a great inconvenience to fast-moving traffic and required constant attention from the road maintenance gangs. At times there were employed in one park as many as twenty-five men, whose sole duty it was to chop off the bumps.

EXPERIMENTS WITH CONCRETE MIXES OF DIFFERENT PROPORTIONS

Four years ago experiments with asphalt macadam pavement were started. These investigations were followed by tests of concrete pavements, and during this year with a number of experimental stretches of penetration work. During 1914 a concrete roadway was laid at one of the main entrances through Forest Park, this work being about the first concrete roadway laid in St. Louis. In order that the department might have the greatest information possible regarding this kind of pavement the entire stretch was divided into sections, in which various mixes and materials were used. The first slab consisted of a 1:2:3 mix, using a 3-in. gravel and Meramec sand. This was followed by a slab using a 1:2:3 mix with 3-in. limestone. The next slab had a 1:2:3 mix using 1½-in. gravel and Meramec sand, while in the fourth one, 1½-in. limestone was used instead of gravel. This same change of material was repeated through the mixtures of 1:2:4, 1:2½:5 and 1:3:6. Single roadways were made 40 ft. wide with armored joints and ½-in. fillers spaced every 35 ft. All slabs were reinforced with American Steel & Wire Company's style 27 fabric. The reason for having the comparison between stone and gravel was that the engineer-in-charge was of the opinion there was a higher coefficient of expansion and contraction in gravel than there was in limestone.

CRUSHING TESTS

As each of the slabs was poured a sample of the concrete as it came out of the mixer was taken and put into a testing laboratory cylinder. The samples were crushed at periods of 4, 8 and 16 weeks after being poured. The crushing tests indicated that the 1:2:4 mix using 1½-in. gravel gave the highest compression unit stresses, and the 3-in. gravel gave a low breaking stress. The 1½-in. limestone ranked second and the 3-in. limestone third.

In a section adjoining the one described hydrated lime was used in varying proportions. The proportions of the cement, sand and coarse aggregate, also varied. There is no doubt, stated Mr. Cunliff, that the introduction of hydrated lime makes a better pavement for concrete roadways than those in which no lime is used. It is easier to trowel the surface of the roadway, and that section in which hydrated lime is used seldom develops any map cracks such as are sometimes found in pavements made with ordinary Portland cement.

PLACE STRAIN GAGE PLUGS

A few months after this pavement was in place steel plugs 1 in. in diameter and about 4 in. long were placed in the pavement about 10 in. on each side of the armored joint in each slab. These plugs were so placed that a longitudinal and a transverse reading on the slab might be taken, and that two readings across the joint might also be obtained. These readings were taken by means of a 20-in. strain gage. The accompanying photographs illustrate the arrangement of the plugs and the methods of recording temperature or moisture content movement in the slab and across the joints. Along with the strain gage readings the temperature and humidity of the day on which readings were made are recorded. Inasmuch as this pavement has not been down a year no attempt to draw any conclusions at the present time from these readings has been made, but it is felt that they will prove valuable in showing the results obtained in the way of decreasing movement in the slab through increasing the density of the concrete by a richer mix, or by the addition of hydrated lime.

NINE TYPES TRIED IN 1915

This year the department set aside a 1650-ft. strip of traffic roadway through Fairground Park for experimental purposes. This is the only traffic roadway crossing the park, and is subjected to a great deal of heavy hauling together with

EXPERIMENTAL SECTIONS OF ROAD IN FAIRGROUND PARK

1—Penetration 2—Concrete 3—Rocmac

a moderate amount of pleasure vehicles. About 700 ft. of this experimental strip is set aside for a Rocmac pavement, 50 ft. for a 1:2:4 gravel concrete reinforced, 50 ft. 1:2:4 gravel without reinforcement, 50 ft. of 1:2:4 limestone reinforced and 50 ft. of 1:2:4 limestone without reinforcement. These sections all have armored joints with a felt filler set at an angle of 22 deg. with the center line of the pavement, which is 33 ft. wide. Next is a 200-ft. strip of Tarvia X penetration. The wearing course is composed of a 4-in. course of stone that passes a 3-in. ring and is retained on a 2-in. ring, compacted to 3 in. For the first coat 1½ gal. of Tarvia X per square yard is used, and ¾-in. limestone is used to fill the voids in the 3-in. stone. Then a seal coat of ½ gal. to the square yard is applied. Pea gravel is used as a finish or wearing course.

The next two stretches of pavement are made in a way similar to the last one described. In the first one Stanolind C is used and in the second Texaco 96 is used. The last stretch is made along the same lines, using 1½ gal. of Tarvia X for the first coat of penetration work and ½ gal. to the square yard of Texaco 96 as a seal coat. It is realized that the dealers in the various types of bituminous materials do not approve of this latter type of construction, but it has been carried out with the idea of following a theory based on the following ideas: When tar is applied to a stone it seems to penetrate into the pores of the stone no matter how thick the layer of dust there may be on the surface of the stone. One is never able entirely to peel back the tar or to obtain a line of cleavage between the tar and the surface of the stone. It is not possible to obtain this result with asphalt. The asphalt may thoroughly coat the stone, but the asphalt may be peeled away from the stone, leaving no discoloration. Since the oils in the tar attack the asphalt an asphalt having a greater consistency than the tar is used. In Mr. Cunliff's opinion the asphalt will produce a better wearing course than will the tar.

LEFT—SIX PLUGS PERMIT TWO LONGITUDINAL READINGS, TWO TRANSVERSE READINGS AND TWO OVER JOINT

RIGHT — READING STRAIN GAGE ACROSS JOINT — NOTE STANDARD STEEL BAR FOR CHECKING STRAIN GAGE

The cost data records of this department for large areas of the types of pavements are given in the table.

Unit Costs and Quantities of Material for Experimental Pavements in St. Louis

	Stanolind	Tarvia	Texaco, 96
Binder per square yard, gallons	1.9	2.1	2.0
Depth of material in feet	0.45	0.55	0.42
Cost of binder per gallon, cents	5	6.5	6.5
Labor cost per square yard, cents	17.5	20	17.5
Material cost per square yard, cents	22.0	32	25.0
Total cost per square yard, cents	39.5	52	42.5

	Tarvia bottom, Texaco top	Concrete	Rocmac
Amount road binder to square yard	1.5 gal. 0.5 gal.	1.1 sacks cement 1.9 cu. ft. sand	1.53 gal.
Depth of material in feet	0.33	0.50	0.44
Cost of binder per gallon, cents	6.5	38.75	20
Labor cost per square yard, cents	18	32	17
Material cost per square yard, cents	25	93	43
Total cost per square yard, cents	43	125	60

How Shall Patented Materials or Processes on Public Works Be Handled?

Daniel B. Luten Discusses S. Whinery's Recent Article from the Viewpoint of the Bridge Patentee—Mr. Whinery Replies

After pointing out certain undesirable features of present practice in the use of patented materials or processes in public work, S. Whinery, consulting engineer, of New York City, in an article on page 73 of the Engineering Record of July 17, advocated the payment of all royalties directly by the city or State. Last week there was published (page 511) a communication from George C. Warren of Boston disagreeing with Mr. Whinery's recommendation in the field of road construction. Daniel B. Luten of Indianapolis, who controls certain patents for concrete arch bridges, has sent to the Engineering Record the following letter, to which Mr. Whinery has replied.—Editor.

Daniel B. Luten's Letter

The full text of Mr. Luten's letter is given below:

"The article by S. Whinery in your issue of July 17, page 73, entitled "State Should Deal Directly with Patentees of Processes and Materials in Public Work," presents an interesting viewpoint of some of the difficulties popularly supposed to confront the use of patents in public lettings. Mr. Whinery has presented the matter in the way in which it no doubt appeals to the average contractor and engineer, but engineers and contractors are often misinformed as to patents, and frequently believe that things are as they wish them to be rather than as they really are. Their wish is father to their thoughts. I believe it is this lack of proper information and correct thought as to patents that is responsible for the difficulties of using patents in public work, rather than the reasons given by Mr. Whinery.

"I have no objections to Mr. Whinery's solution of having the State or city pay the royalty provided this will give the results desired; that is, the use of patented devices where meritorious. But it does not. One reason why it does not is shown by the following illustration: My plans were filed by the city of Topeka, Kan., for a bridge with the usual 10-per cent royalty clause. The following item appeared in a Topeka daily:

TEN PER CENT RAKE-OFF
City Must Pay Royalty to Luten
for New Bridge

The city of Topeka will pay tribute to Daniel B. Luten of Luten bridge-patents fame. Ten per cent of the contract price of the bridge to be built over the Shunganunga Creek on Kansas Avenue will go to Luten. "It is cheaper to pay the royalty than to try to build a bridge not infringing on the Luten patents," said W. G. Tandy, city commissioner of streets. "We tried to adopt a plan for the bridge which would not infringe on Luten's rights, but to do so would cost more. As to whether or not Luten should have been granted his patents by the Government is not for us to consider. The point we must consider is that he has these patents."

Luten holds forty-one patents on the construction of bridges. If a bridge is desired with an arch of a certain degree of curve, Luten has a monopoly on that kind of an arch. There are 360 deg. in a circle, but Luten was satisfied to secure only forty-one patents.

"The above was of course inspired by some contractor who happened to meet the reporter and suggest such a story. He doubtless had been impressed by such arguments as those advanced by Mr. Whinery. His object, however, was to gain an advantage for himself by placing obstacles in the way of the introduction of new devices in concrete bridges. Contractors and engineers frequently oppose such innovations for the same reason that union labor opposes new machinery, because they believe that it limits their individual opportunities. The benefit to the public, or to the profession, receives scant consideration.

DIFFICULT TO INTRODUCE INVENTIONS

"Mr. Whinery by his proposed reforms would make it more difficult for the patentee to introduce his invention. This is already difficult and must be done in the face of serious opposition by those who always favor the old and tried methods. The above newspaper clipping shows how embarrassing it may become for a public official to specify meritorious patented improvements in the face of possible newspaper criticism inspired by prejudiced bidders.

"In that particular instance the use of the patents saved the city upward of 25 per cent and the royalty charge was but 10 per cent of contract price. Nevertheless the reporter made a false statement as to what the patents covered and became quite facetious in his criticism of what was really beneficial to the taxpayers.

"In fifteen years' experience in the promotion of my own patented devices on public work I have come to believe that the prejudice against patented devices does not exist at all in the public mind, but comes primarily from contractors and civil engineers. The only prejudice on the part of the public is against the possibility of eliminating competition on public work by their use. And this prejudice, slight as it is, is sedulously cultivated by contractors and engineers who imagine that their own opportunities will be limited. Mr. Whinery's article will have this same effect.

ENGINEERING PREJUDICE AGAINST PATENTS

"As an example of the prejudice shown by members of the engineering profession, I beg to quote the following from a letter written by an engineer in Iowa in public office:

" 'Personally I am opposed to patents on any kind of reinforced-concrete work. As an engineer I feel that any member of the profession who fosters such patents that tend to burden the public with patent royalties is doing the present age a great injustice and is a disgrace to the profession. If occasion should arise, I will freely give my time and money to fight them to the last ditch.'

"This official is sworn to uphold the constitution of the United States, which contains the following:

" 'The Congress shall have power to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries.'

"Note the contrast between the engineer who believes that patents burden the public, and the constitution, in which it is held that patents promote the progress of science. It was in Iowa that the anti-Cameron patent association was organized; Iowa is the State that has an engineering college that has frequently shown its antagonism to patents; Iowa has a law providing that the Attorney-General may defend suits for infringement of road and bridge patents, and it was an Iowa engineer that advocated at a road convention that the United States Government should at its own expense defend infringers and thus encourage violation of its own patent grants! This engineer above quoted might well be an exception, but I have numerous other similar opinions from other States.

ONLY SUCCESSFUL PATENTS ARE OPPOSED

"Opposition does not arise against a patent until it becomes a success. This shows again that the prejudice of engineers and contractors grows out of selfish motives. But strangest of all the engineer's and contractor's prejudice is rather against payment of royalty as such than against the purchase of a patented device. Engineers will specify and contractors will purchase deformed bars for reinforcement at a price that pays a handsome royalty, when they hesitate to recommend or use a patented device that the contractor can make himself, provided he purchases the right from the patentee. Thus, strange as it may seem, a monopoly due to special machinery or heavy investment of capital receives more encouragement than the reward for an intellectual achievement such as an invention.

"An established royalty is nearly parallel to an engineer's fee, and an established royalty of 10 per cent ought to go far to meet the criticisms that have lately been launched against low fees by engineers. If 10 per cent can become a popular charge for royalties on engineering patents, it will be at least one step toward the payment of higher fees for engineering alone.

TWO FLAWS IN MR. WHINERY'S ARGUMENT

"I find two serious flaws in Mr. Whinery's argument, and they are at the root of all the criticism directed at patents on public work. Mr. Whinery assumes that a patent can be extended to create a monopoly on unpatented materials. He also assumes that a patentee may not fairly compete with other bidders on his own patented device, even when the patent is thrown open to all bidders by naming a specific royalty. Neither assumption is sound.

"Taking up the last first, because the illustration is more striking, let us assume that a patented pavement is to be let, to cost, say, $10,000 to construct; that there are to be several bidders, including the patentee, and that they will all arrive at exactly this same cost of $10,000 in their estimates. In order to make the contrast more striking let us assume that the royalty is specified at an excessive amount, say $10,000, or 100 per cent of the cost. And let us assume the profit figured by each bidder to be small, say 1 per cent, or $100. Now surely if the patentee has any advantage over the other bidders by reason of his $10,000 royalty, it will be greater because of this excessive royalty and diminished profit than if each were reasonable.

"But suppose the patentee endeavors to take advantage of his excessive royalty to reduce his bid in order to secure the award, and he cuts $200 off his bid. He would bid $19,900 as against $20,100 by each of his competitors. But when he computes his profits, he will find that he has but $9,900, whereas if he had refrained from bidding at all he would have received $10,000 in royalty. And if he reduces his bid by more than the $100 profit figured by each bidder he is a loser. In short, the patentee cannot take advantage of his royalty to secure the work.

"As another illustration suppose Smith loses a $20 gold piece under a sidewalk. The owner of the walk calls for bids to remove the walk and restore Smith his $20. Smith concludes to bid against the others. Can Smith bid lower than his competitors by reason of having a claim for the $20 which the others must restore to him? Of course not.

UNDERBIDDING MUST SACRIFICE PROFITS

"Then if a patented improvement is to be let, and Smith by reason of a patent has a claim for $20 from each of the other bidders, it must be obvious that the only reduction Smith can make is in his profits, and each of the other bidders can equally afford to make a similar reduction except for the inequalities of skill and capital and equipment that always exist. If this applies to the patentee it also applies to his agent, the only condition being that any commission paid to agents must be paid regardless of who receives the award. And this is the same condition that makes an agent valuable to a patentee; that is, that he shall give services toward promotion for a commission.

"It has been the finding of the courts that a public letting is fair to all when the patentee bids against other competitors, provided a royalty is specified so that bidders may have access to the patent. Nevertheless Mr. Whinery advances as one reason for his proposed plan that it would prevent direct dealings with the possibility of collusion or corrupt arrangements between contractor and patentee, but he gives no example of what would constitute such an arrangement.

THE PATENTEE'S AGENT

"If a special price is quoted to one contractor conditioned only on his getting the work, then possibly favoritism might result. But what possible object would it be for the patentee to make such an arrangement, and has it ever been done? If the special price is a concession made to him regardless of who gets the contract, there can be no favoritism. It is doubtless failure to appreciate this view that has led Mr. Whinery into his criticisms. If a patentee is debarred from employing agents, who in many cases will be forced to bid themselves in order to gain introduction of the patented devices, then the introduction of patented devices will become a tedious process indeed.

"Mr. Whinery, however, argues that if the commission which the agent receives for promoting had been allotted instead to the other bidders by reducing the royalty by that amount, the city would have been benefited by correspondingly lower prices. As a matter of fact the city would never have heard of the patented improvement under those conditions. Mr. Whinery's suggestion recalls the hunter's excuse, 'We would have killed the rabbit if we hadn't missed him.' Furthermore, even if there were any unfairness in the patentee or his agent bidding, the taxpayer would have been the beneficiary by the amount of the advantage gained. And courts and legislatures will hesitate long before finding in favor of the contractor as against the taxpayer.

EXTENDING MONOPOLY TO UNPATENTED MATERIALS

"On the other false assumption, that a patent can be extended to create a monopoly on unpatented materials, Mr. Whinery, of course, refers to the practice of offering for sale by the patentee, not only the right to use but combined therewith some more tangible property as paving material. It is refreshing to find Mr. Whinery saying that 'an invention protected by patent is as much the private property of the patentee as his real estate or his chattels.' Mr. Whinery will hardly deny that it is entirely proper for the owner of a lot to sell it with the proviso that building materials shall be purchased from him. The only harm done is to the patentee himself in case he makes his conditions so onerous that it embarrasses the sale of his products.

"The purpose of the patentee in including materials with his royalty is often to avoid the prejudice of engineers who are willing to pay a higher price for a patented article but will not pay royalty alone for 'blue sky,' as they sometimes express it. Another reason is that the essential elements required for good construction and satisfactory service of the patented improvement can thus be assured by the patentee himself, the party usually most interested, and not left to the haphazard efforts of incompetent contractor or lax inspector.

"Mr. Whinery attempts to make of this feature an objectionable monopoly under which the patentee can supply inferior goods. As such it can accomplish no purpose. The patentee has the right to charge anything he may elect for his royalty. Suppose he charge a high rate and make a free gift of the paving pitch to the contractor, is anyone injured? The Supreme Court has ruled in the Dick case that the patentee has the same right that an owner of real estate has to name the terms under which his property may be used. If I choose to specify that the right to use my patents in a bridge, together with the reinforcing steel and the cement, will be furnished for a given sum, in order that no skinning in cement or steel may result, I fail to see how I have extended a monopoly. For the assumed excessive profits on the materials that must constitute the alleged monopoly could have been secured to me any way by specifying a higher royalty.

OBJECTIONABLE PRACTICES RARE

"All of this Mr. Whinery dismisses as objectionable by saying, 'The practices resorted to for this purpose are too well known to need description here.' I beg to differ. I have never heard of any such objectionable practices except the highly imaginary newspaper editorials following the Dick decision by the Supreme Court, and I doubt not that Mr. Whinery has drawn his inspiration from those sources rather than from actual abuses. If such is not the case, will not Mr. Whinery illustrate a few of the abuses by actual examples to facilitate discussion?

"Mr. Whinery argues that few patented devices are useful and that great conservatism should be shown before adopting them. But the patented device has at least one advantage in this respect over all competitors, for the law permits the issue of a patent only for useful improvements, and the issue of a patent is proof that at least the trained experts of the patent office hold it to be useful. As much could never have been said for some unpatented monopolies, as, for example, certain brands of asphalt pavements. The patent office never grants a patent for an alleged perpetual-motion machine but calls for a working model.

"If the above arguments are sound, Mr. Whinery's seven distinct advantages disappear. But if the article written by Mr. Whinery shall have resulted in a thorough discussion of these greatly misunderstood features of patent promotion, a great good will have been done the engineering and contracting professions, and I sincerely hope, therefore, that the whole subject may be given a thorough airing in your journal."

S. Whinery's Reply

Mr. Whinery's reply is as follows:

"The communication from Mr. Luten that you have kindly submitted to me for comment may be summarized as a plea for the more favorable treatment of the patentee and his inventions, a contention that the prejudice against patented articles and processes is wrong and without adequate foundation, and a criticism of my article in your issue of July 17, on the ground that, in common with engineers and public officials, I am prejudiced against patentees, and that my suggested plan for the State to pay definite royalties to patentees is impracticable and unfair to the patentee.

"Either Mr. Luten did not read my article with care, or I fail to understand some of his statements. I thought I made it clear that I am not only not prejudiced against or opposed to patents, but strongly advocate fair and just treatment of patentees and meritorious inventions. What I am opposed to, in common with officials, engineers and honest people generally, is the employment by patentees and their associates of questionable, underhand and crooked practices to hoodwink and defraud the public for the purpose of making illegitimate profits.

"As was made clear in my article, I confined my attention mostly to the use of patents in connection with pavement and road work. I cannot say with confidence from personal knowledge and experience to what extent my remarks apply to other fields of public work. There is undoubtedly a well-defined public belief, based upon much circumstantial and not a little direct evidence, that some pavement and road patents have been used by the patentees, or by contractors favored by them, to extort unreasonable and excessive profits over and above a fair and liberal royalty. Mr. Luten seems to question the existence of such practices except in rare cases, and challenges me to name specific cases. To do so here would be of doubtful propriety, even if the space necessary to state the facts in such fullness and detail as would satisfy a doubter were available. But if Mr. Luten wishes to pursue the matter further I will be glad to refer him personally to facts and court records that will justify all the statements made by me.

THE TWO FLAWS MR. LUTEN CITED

"Mr. Luten says he finds two serious flaws in the argument of my article, and that they are at the root of all the criticism directed at patents on public work. One of these is the assumption that a patent can be used to create a monopoly on unpatented articles. I did not say exactly this, but no matter. He refers to the Dick case, and I am willing to rest my statements on the evidence offered in that case and the argument presented by Chief Justice White in his dissenting opinion. Besides, as Mr. Luten knows, the position of the court on the questions involved has been greatly modified in a subsequent case.

"The other flaw found by Mr. Luten is stated thus: 'He also assumes that a patentee may not fairly compete with other bidders on his own patented device, even when the patent is thrown open to all bidders by naming a specified royalty.' If he will read the article more carefully he will find I said exactly the contrary. The question of a proper royalty having been agreed upon between the State and the patentee, the latter should be free, as stated in the article, to bid for the work upon exactly the same footing as other contractors. If he should think it wise to be satisfied with a smaller profit, and to underbid other contractors in order that he might insure the proper doing of the work and maintain the good reputation of his patented product, the public would certainly not object. The question of a fair and just royalty for the use of the patent is one thing; that of the cost of the work independent of the royalty would be quite another, determined by fair and open competition, except that the patentee would still have some advantage over other bidders if he were willing to encroach upon his royalty for a part of his reasonable profit on the work.

"Under such a fixed-royalty arrangement the patentee would not be estopped, as Mr. Luten asserts, from promoting the adoption and use of his patent by every legitimate means, such as advertising, agencies or personal efforts, but expenses thus incurred would be chargeable to the royalty account and might properly be considered and allowed for in fixing the royalty.

GROUND FOR PREJUDICE

"There must, of course, be some ground for the distrust and prejudice that exist against patents and patentees, particularly when it is found to be quite prevalent among so able, open-minded and disinterested a class as the professional engineers of the country. What personal or professional interest could they have in opposing meritorious inventions and improvements? The truth doubtless is that so many practically useless patents have been issued (Mr. Luten's ratiocination that all patents issued must be useful because the fundamental patent law stipulates that patents may be issued for useful inventions is, in the face of facts, amusing), and so many of those having merit have been exploited by questionable and crooked methods, that people have come to distrust patents generally, and to be suspicious of the motives and methods of patentees. The situation is most unfortunate for both the public and for the patentee who has something of value to offer and desires to introduce and promote it by legitimate and honest methods only. This class of patentees can best help to improve the situation by denouncing and fighting the other class, instead of by seeming to defend them by contending that abuses exist only in rare cases.

"The agreement by competent and responsible officials upon a fair and reasonable royalty, and its payment directly by the State, would clear the way for fair and reasonable competition in contract work involving patent rights, and would do more than any other one thing to improve the present conditions.

"It does not appear to me that Mr. Luten presents any valid or weighty arguments against this plan. It is clear that he does not think it would enlarge the present opportunities or profits of the patentee. That, however, is not the crux of the matter. The problem is to devise a method of dealing with patented articles and processes in connection with public work that will be just and fair to the patentee, will protect the public from imposition, and will place the introduction and use of patented articles and processes upon a sound and equitable business basis. If this can be done meritorious inventions will come to be welcomed, and the present prejudice against patents and patentees will tend to disappear."

Paving Crown Best Distributed by Hyperbolic Curve

New Formula Has Been Developed in Kansas City Where Parabolic Sections for Streets Have Been Abandoned

By CLARK R. MANDIGO
Assistant City Engineer, Kansas City, Missouri

WHY the parabolic form of paving crown receives so much attention has always been a mystery to the writer. In spite of the fact that few engineers follow the true parabola in laying out crowns the parabolic crown continues to get columns of space in periodicals and pages in text books. Highway engineers have recognized the necessity for some sort of a curved cross-sectional surface for pavements, but have not been satisfied with the distribution of the cross fall when either the parabolic or circular form is used.

On high-crowned pavements the cross fall near the sides is too great and on flat-crowned roadways the fall near the center is too little. There are also obvious objections to plane sides or to two tangents connected by a circular arc, although both of these have been used for lack of something better. Many engineers have followed the practice of specifying the total crown and the amount of drop to the quarter point, with instructions to round the pavement between points so that it "looks good." With men of experience and inspectors whose eyes can be depended upon, such a distribution has worked out fairly well on narrow pavements, but on wide pavements and flat crowns on city streets, where close and careful design is necessary or templates have to be cut, such a method is not satisfactory.

R. S. BEARD'S FORMULA

In order to get a curved cross-sectional surface which would answer all requirements, Robert S. Beard, office engineer in the city engineer's office of Kansas City, Mo., has worked out the street crown formula given below. Taking the surface of the pavement at the center as the origin, the general equation for a street crown of any conic section is found to be

$$x^2 = \frac{cw^2y(m^2 - 4) - mw^2y^2(m - 4)}{16c^2(m - 1)}$$

where

x = the horizontal distance from the center,

y = the vertical distance below the top of the crown,

c = total crown of the street,

w = total width of the street between curbs,

c/m = the value of y at the quarter points.

When $m = 2$, $x^2 = w^2/4c^2y^2$, the equation of two straight lines; that is, when one-half of the crown is the drop given at the quarter points the crown becomes two planes intersecting at the center of the street. When $m = 4$, $x^2 = w^2/4cy$, the equation of the parabola. If one-quarter of the crown is the drop given at the quarter points the pavement takes the parabolic form.

When m has a value between 2 and 4, the crown curve is a hyperbola lying between the straight line and the parabola, and for values greater than 4 it is an ellipse.

For use on roadways with no car tracks Mr. Beard has worked out a hyperbolic section in which $m = 8/3$, that is, three-eighths of the total crown is the drop given at the quarter point. The general equation of this hyperbolic section is

$$x^2 = (w^2y/60c^2)(8y + 7c)$$

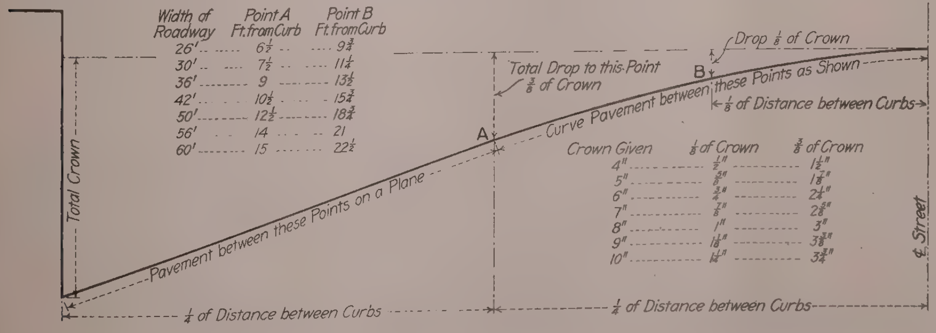
or

$$y = c/16(-7 + \sqrt{49 + 1920x^2/w^2})$$

If x is expressed in units of 1/24 of the width of the pavement, w, and p is the number of these units from the center of the roadway, the last equation becomes

$$y = c/16(-7 + \sqrt{49 + 10p^2/3})$$

This equation is of special form for determining the total vertical drop at any twenty-fourth point of the roadway width.


Total Crown
Total Drop to this Point $\frac{3}{8}$ of Crown
Drop $\frac{1}{8}$ of Crown
A
B
Pavement between these Points on a Plane
Curve Pavement between these Points as Shown
$\frac{1}{8}$ of Distance between Curbs
$\frac{1}{4}$ of Distance between Curbs
$\frac{1}{4}$ of Distance between Curbs
℄ Street

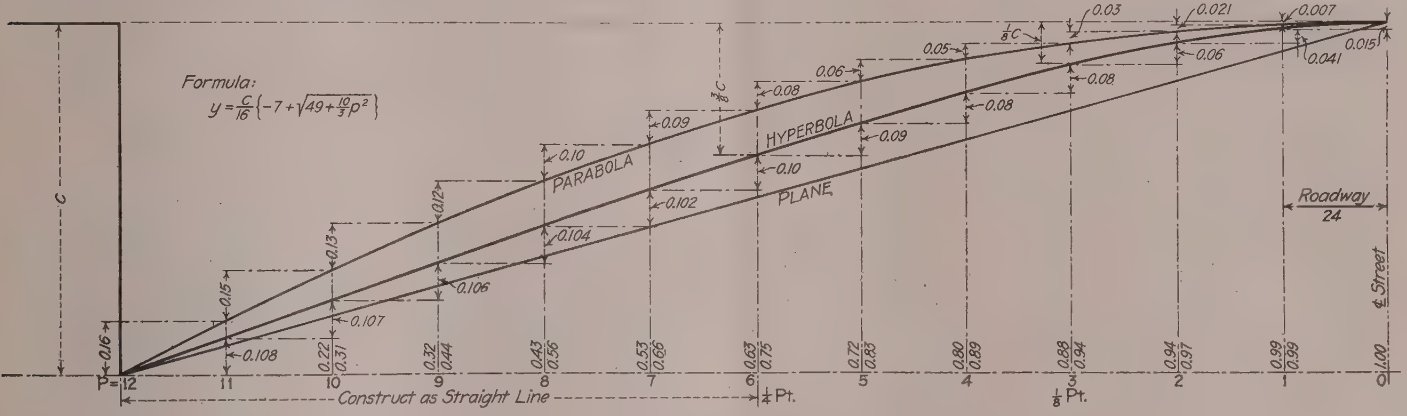
Width of Roadway	Point A Ft. from Curb	Point B Ft. from Curb
26′	6½	9¾
30′	7½	11¼
36′	9	13½
42′	10½	15¾
50′	12½	18¾
56′	14	21
60′	15	22½

Crown Given	⅛ of Crown	⅜ of Crown
4″	½″	1½″
5″	⅝″	1⅞″
6″	¾″	2¼″
7″	⅞″	2⅝″
8″	1″	3″
9″	1⅛″	3⅜″
10″	1¼″	3¾″

THIS CHART GIVES THE PAVING INSPECTOR THE INFORMATION HE NEEDS

THE DIAGRAM BELOW

The diagram compares this curve with the parabolic form of cross-section. It gives the portion of the total crown rise in each one-twelfth unit of distance from the gutter to the center of the roadway by figures along each of the curves, and the total accumulated proportion of the total crown rise above the gutter for each curve by twelfths along the base line. It will be noticed that on the hyperbolic section the rise from the gutter to the point half-way to the center is almost exactly a straight line, the variation at the extreme ends being less than 1 per cent of the total crown. This portion of the pavement would, therefore, in practice be constructed as a straight line. From the quarter point to the eighth point the rise is almost exactly two-eighths of the crown, the remaining one-eighth rise being distributed in the center eighth section.



COMPARISON OF HYPERBOLIC SECTION ADOPTED AND PARABOLIC SECTION ABANDONED FOR KANSAS CITY STREETS

In actual construction of pavements less than 50 ft. wide the special hyperbolic section could be assured by the following rule: The total crown being given, let the surface of the pavement fall one-eighth of the crown in the first one-quarter of the distance from the center to the gutter, three-eighths of the total crown from the center to the point half way to the gutter, and from this point make a plane surface to the gutter. It will be seen that such a curve provides twice the fall that the parabola does from the center to the eighth point, and 50 per cent more fall from center to quarter point, and that the rise in the first quarter next to the gutter is one-eighth of the crown less than that called for by the parabola and is uniformly distributed. This proposed section, therefore, very materially modifies the chief criticism against the parabolic form.

PARABOLIC CURVE ABANDONED

No attempt has been made for the past five years to follow the parabolic form of paving crown in Kansas City. The distribution of the crown has not followed any fixed curve, but has been whatever experience has shown gives the best riding and best drained pavement. With the gradual decrease in the amount of crown incident to greater care in construction and better riding qualities, and with the increased use of the template for the mortar cushion of block pavements, and for the testing of the finished surface of concrete and asphalt pavements, the necessity for a satisfactory rule for determining the distribution of the crown became increasingly apparent. It was found that the best proportioned crowns followed very closely the hyperbolic section, where *m* equaled 8/3.

The hyperbolic section shown on the diagram has, therefore, been adopted recently for the surface of all pavements not on car line streets with excellent results. On streets with car tracks, where the distance from the rail to the gutter is 12 ft. or less, the block pavements are laid as a plane surface with a uniform cross fall from track to curb varying from less than ¼ to nearly ⅜ in. to the foot, according to the kind of pavement used and the grade of the street. On asphalt streets where there is less than 22 ft. between the curb and car track, and on other pavements where the distance is between 12 and 22 ft., the plane is varied slightly by using 7/3 for the value of *m* in the formula, deducting, of course, the space occupied by the rails from the width between curbs for *w*. (It is difficult to roll properly sheet asphalt laid without some curve in the cross-section.) The formula gives then a drop of practically 1/6 of the crown at the eighth point and 3/7 at the quarter point. For greater widths of pavement on car line streets the regular ⅜ quarter-point formula should be used.

FLEXIBILITY OF HYPERBOLIC FORMULA

These examples should be sufficient to show the flexibility of the hyperbolic formula. Although more complicated in appearance than the parabola, it is more simple in operation, as the quarter point drop is always assumed and on all except the widest streets it is only necessary to calculate the drop at the center eighth point since the quarter point next the curb is constructed as a straight line. A formula for the value of *y* at the eighth point in terms of *m* and *c* can be easily worked out if needed.

It should be remembered that the nearer the value assumed for *m* is to 2 the more nearly the cross-section becomes two planes, and the nearer *m* is to 4 the more nearly it approaches our old enemy, the parabola. The writer believes the special section in the diagram proposed by Mr. Beard will give the best results on city streets, *m* being 2 2/3. It is suggested that this cross-sectional pavement curve be tried in other cities and the results as to general appearance, drainage and riding qualities be reported.

A SAVING OF $3,296 ON SEWER WORK completed this year by the city of Victoria, B. C., is indicated in a report to the streets committee made recently by City Engineer C. H. Rust. The work included the construction of the outfall for the northwest sewer system at Macauley Point, for which bids were asked last fall. The lowest tender, $6,230, was considered excessive, and upon recommendation of the city engineer it was decided to build the outfall under the direction of the city's engineering department instead of by contract. This was done at a cost of $2,934.

Literature

For the Civil Engineer and Contractor

New Publications

YEAR BOOK OF NEW YORK SOCIETY OF ARCHITECTS, 1915 Limp leather; 6 x 9 in.; 241 pages, tables and diagrams. New York, United Engineering Society Building.

Contains building laws of all the boroughs of New York City, provisions from State laws, and rules and regulations of a number of State and municipal departments. Much of this information is of value to the builder as well as the architect. Building statistics covering several years in New York City and a chapter on the history of Greater New York are given.

LOOKING SQUARELY AT THE WATER POWER PROBLEM. By Henry J. Pierce. Cloth, 6 x 9 in.; 66 pages; illustrated; 7 appendices. Seattle, Wash., published by the author.

STRENGTH TESTS OF STRUCTURAL TIMBERS TREATED BY COMMERCIAL WOOD-PRESERVING PROCESSES. By H. S. Betts and J. A. Newlin, engineers, Forest Products Laboratory. Bulletin 286, U. S. Department of Agriculture. Paper; 6 x 9 in.; 15 pages, diagrams. Washington, D. C., Superintendent of Documents.

LOAD DISTRIBUTION TESTS OF REINFORCED-CONCRETE SLAB FLOORS UNDER CONCENTRATED LOADS. Bulletin 28, Ohio State Highway Department, Clinton Cowen, State Highway Commissioner. Paper, 6 x 9 in.; 97 pages; illustrated, tables and diagrams. Columbus, Ohio, State Highway Department.

ELEMENTS OF RAILROAD TRACK AND CONSTRUCTION. Second Edition. By Winter L. Wilson, professor of railroad engineering, Lehigh University. Cloth, 4¾ x 7½ in.; 396 pages; 210 figures. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $2.50 net.

STATISTICS OF RAILWAYS OF THE UNITED STATES, 1904-1914. Bulletin 81 of the Bureau of Railway Economics. Paper, 6 x 9 in.; 67 pages; 76 tables. Washington, Bureau of Railway Economics.

This is the third annual edition of this report, the second, for 1903-1913, appearing last March. It is made up entirely of tables, on population and area; railway mileage; capital securities and dividends; revenues, expenses and taxes; employees and compensation; equipment; freight-traffic statistics; passenger-traffic statistics, and accidents.

THE TOXICITY TO FUNGI OF VARIOUS OILS AND SALTS, PARTICULARLY THOSE USED IN WOOD PRESERVATION. By C. J. Humphrey, assistant pathologist, and Ruth M. Fleming, scientific assistant, Office of Investigations in Forest Pathology. Bulletin 227, U. S. Department of Agriculture. Paper, 6 x 9 in.; 38 pages; 4 plates. Washington, Government Printing Office. 10 cents.

COTTON WAREHOUSE CONSTRUCTION. By Robert L. Nixon, assistant in cotton marketing. Bulletin 277, U. S. Department of Agriculture; contribution from Office of Markets and Rural Organization. Paper, 38 pages; 13 figures. Washington, Government Printing Office. 10 cents.

INVESTIGATION OF THE CONCRETE ROAD-MAKING PROPERTIES OF MINNESOTA STONE AND GRAVEL. By Charles F. Shoop, assistant professor of experimental engineering, University of Minnesota. Bulletin 2, University of Minnesota. Paper, 7 x 10 in.; 55 pages: illustrated.

An advance report on this Bulletin was published in the Engineering Record of March 27, 1915, page 390.

APPLICATION OF THE THEORY OF LEAST SQUARES TO THE ADJUSTMENT OF TRIANGULATION. By Oscar S. Adams, computer, U. S. Coast and Geodetic Survey. Special Publication 28, U. S. Coast and Geodetic Survey. Paper 6 x 9 in.; 220 pages; tables and diagrams. Washington, D. C., Government Printing Office.

THE TORONTO HYDROELECTRIC SYSTEM. Fourth Annual Report, 1914. Paper, 8 x 11 in.; 26 pages; illustrated. Toronto, Can., Toronto Electric Commissioners.

Books Reviewed

Steam-Boiler Economy

Second edition. Author, William Kent, Sc.D. Cloth, 5½ x 9 in.; 717 pages; 287 illustrations. New York, John Wiley & Sons, Inc. $4.50 net.

Since the first edition was published in 1901, such important changes have taken place in boiler design and operation that the author has made extensive changes to make the book conform to present practice. Among the changes and their results that are discussed are size of boilers and their better construction and increased rate of running, coal and ash-handling machinery, mechanical stokers, gas analysis, superheaters, draft and temperature-measuring apparatus, purchase of coal under specification, treatment of feed water, bonus and premium systems of paying wages. Chapters on boiler design and construction and on boiler attachments and boiler-room appliances have been added. That the book has really been revised is shown by the late heating values of coal quoted and by the new A. S. M. E. code for boiler construction and operation, as well as reference to forms of apparatus and methods of operation that have been developed since the first edition was published.

With its many changes this well-known book should find an increased field of usefulness among owners and managers of power plants as well as among operating engineers and students.

Practical Surveying

Author, Ernest McCullough, consulting engineer. Cloth, 5 x 7½ in.; 401 pages; 229 illustrations. New York, D. Van Nostrand Company. $2 net.

Reviewed by A. F. Comstock

Associate in Railway Engineering University of Illinois, Urbana, Ill.

It is not often, as in this case, that a successful practising engineer of 30 years' experience finds time to write a book dedicated to the education of mere beginners. Most of the numerous texts on surveying assume the student to possess a working knowledge of geometry, algebra, and trigonometry; but the author has elected the part of writing for self-tutored students whose mathematical preparation includes only arithmetic. That there is a real need for a book of this kind seems manifest to one who has attempted to teach students having such limited preparation. That a man of the author's attainments has written such a book with evident care should insure for it a cordial reception.

To picture clearly in words to the untutored mind the essentials of a technical subject is indeed difficult. This the author has done skillfully, both as regards development of the subject and style of writing. Eight chapters constitute the main text divisions and are as follows: Introductory, chain surveying, leveling, compass surveying, trigonometry, transit surveying, surveying law and practice, and engineering surveying. An appendix on "The Essentials of Algebra" concludes the book. Naturally the subject matter has been restricted to plane surveying, and the aim has been also to emphasize land surveying methods. Instruction in elementary mathematics is given as necessity for it arises.

A pleasing effect is produced in the book through a combination of clearness in exposition and description, a practical logic, a conviction born of long experience, and a historical touch running through the description of various methods and instruments of surveying. Throughout there is a fine understanding of the beginner's needs, in serving which adequately the author has produced a book that should interest also surveyors of more mature years.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

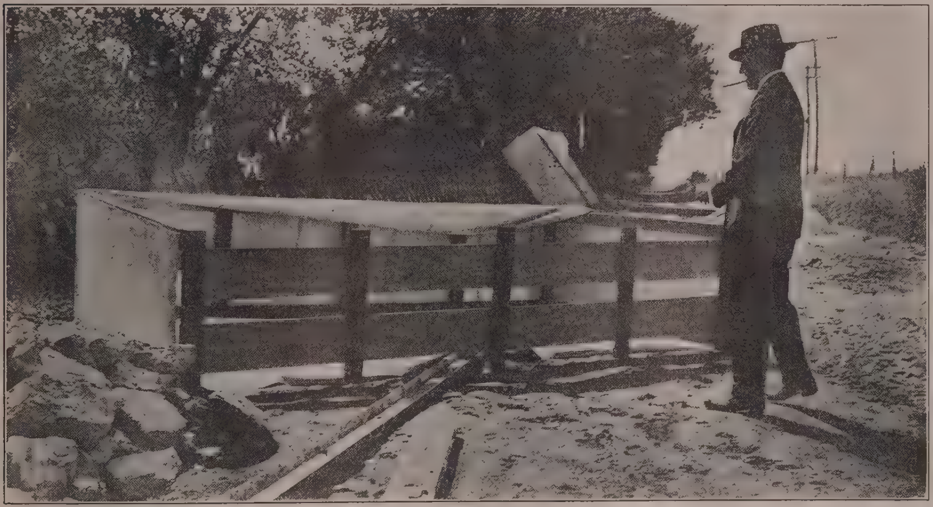
Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Portable Unit Sheds Solve Cement Storage Problem on Road Work

EIGHTEEN-OUNCE canvas stretched tight and tacked with roofing nails over a frame of 2 x 4-in. studs and 1-in. plank makes a waterproof portable cement house which has solved the cement storage problem and eliminated rehandling on concrete roadwork. The front of the house is made by a full-sized flap of canvas, secured by cords around the edge tied to nails in the frame when the house is full.

Twenty or thirty of these sheds have been built. They are distributed at measured distances along the road ahead of the mixers and are filled with 90 bags of cement each. As the cement is used, the sheds are thrown on a cart or on a couple of wheelbarrows and moved ahead.



IN THESE SHEDS CEMENT IS STORED ALONG ROAD AHEAD OF CONCRETE CREW

Instead of using 2 x 4-in. pieces underneath, 4 x 4's should be used to raise the cement higher, if the houses have to be set on wet ground, or to make the floor stronger if the sheds are to be set over a ditch. Some green laborers did this with one of the sheds shown and the floor broke when the shed was filled with cement and several sacks were spoiled. This is the largest loss of cement that has occurred through the use of these sheds, though there have been several heavy rains.

Electric Dragline Makes Record on Reclamation Project

DIRT WAS moved at the rate of two ¼-yd. buckets per minute straight time from noon on Aug. 14 to the end of the month on the drainage excavation for the Boise irrigation project, according to J. L. Burkholder, assistant engineer in the October *Reclamation Record.* For approximately three-fourths of the length of the ditch excavated the hard material had to be blasted, 600 lb. of dynamite being used during the above period. Counting the time actually spent in digging the rate was 3 yd. per minute.

In the 49¼ shifts 58,590 cu. yd. were excavated from a ditch 7910 ft. long. The highest run per shift was 1583 cu. yd. Machine efficiency was as follows: Digging, 77.2 per cent of the total time, 424 hours; mechanical repairs, 13.8 per cent; electrical repairs, 5.8 per cent; moving, 3 per cent; blasting, 0.2 per cent.

Pavements Grouted at One Application Without Separation of Sand

By D. MOOMAW

Road Engineer, Cuyahoga County, Cleveland, Ohio

BY MIXING fairly coarse sand and cement in equal parts with twice the volume of water required to make a mixture of normal consistency, spreading the grout with shovels and pushing it along the pavement with brooms till it fills the joints ahead of the broom, segregation of the sand has been practically eliminated and a perfect filling of the joints secured in building a granite block pavement on the new Brooklyn-Brighton viaduct in Cuyahoga County, Ohio. This method was devised and used under the direction of the county's engineers, and, according to the contractor who put it in practice, proved quicker than the usual way of applying the grout rapidly in three coats.

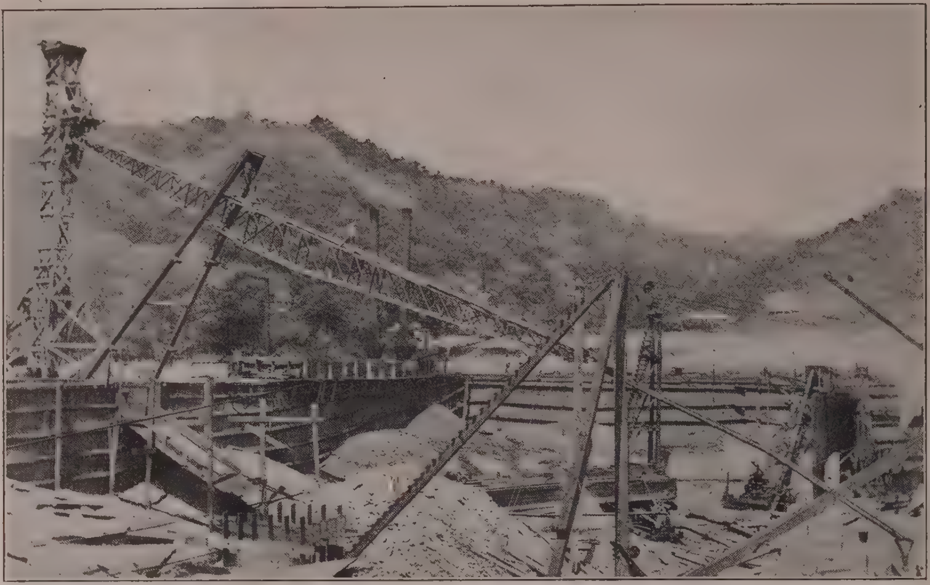
The sand used for grouting was required to be of such size as would pass an 8-mesh screen and not more than 40 per cent pass a 60-mesh screen. Sand and cement were used in equal parts and the water was specified as double the amount necessary to bring the mixture to normal consistency. The sand and cement were mixed dry in the mixing box until a uniform color was obtained. One-half the required amount of water was then added and thoroughly mixed to form a thick mortar, the remainder of the water being then added. The mixture was constantly agitated until the entire batch was removed to the pavement with scoop shovels.

By the use of water in the quantity specified, the amount of water is determined in the laboratory and a more uniform character of grout is obtained. In this particular case determinations were made in our own laboratory on cement and sand after delivery for use. Three determinations were made, one with the sand perfectly dry, one with the sand somewhat damp, and one with the sand quite wet, so that a modification could be made to suit the condition of the sand. Grout mixed in this manner and allowed to set showed by careful analysis a difference in sand content between top and bottom of a 4-in. depth of only 0.9 per cent. From this it is apparent that the viscosity of the mixture is sufficiently high to sustain the sand until setting takes place. Actual experience has shown that it is sufficiently liquid to flow freely into place.

Filling was accomplished in a single application, and the joints were kept full for a period of 45 min. to take care of any settlement, after which time the surface was finished with brooms and left to set. In applying the grout to the pavement with shovels, it was deposited on the last few courses already filled and broomed slowly forward to allow it to run into the joints rather than be swept over them. The joints were not swept over until they had been filled from the bottom up. By this method, few of the joints became air-bound and those few were opened with a small pinch bar and allowed to fill. The pavement was laid on a cement-sand cushion, and it was found that after a period of 45 min. no settlement of the filler was observed.

The advantages claimed for this method are the elimination of the trouble arising from the segregation of the sand and cement, the complete filling of the voids between the paving blocks and a more complete bond between block and filler. This method of application allows the filler to displace the air from the pavement, forming no air pockets, and covering all bonding surfaces complete with no interval for drying out. It absolutely prevents the occurrence of such a condition as the writer recently observed in building a Medina block pavement where the job was stopped for the night after one application of grout had been made. It assures the fullest efficiency of the filler, as no partial filler or intermittent coating of the bonding surface can occur.

Specifications for grouting brick and stone pavements have remained practically unchanged for years. Many engineers having expressed their dissatisfaction with the present methods, and then proceeded to specify them unchanged for their new work. If we specify that the grout shall be mixed to a consistency of thin cream, we should be consistent and specify that the coarse aggregate for concrete should be the size of green apples. If we require that sand shall not separate from the cement, we should not specify a method that will insure such separation. If we demand that the grout filler shall rigidly bond the brick or stone together, we should not leave its accomplishment entirely to the judgment of an inspector. It is as a remedy for some of the shortcomings of the present practice that the writer wishes to submit for the criticism of others the methods outlined above.



TRUSSED BOOM CUT IN TWO TIME REQUIRED FOR RIGGING CHUTES AT EACH MOVE

Long Reach Given Mixer Boat by Trussed Boom Supporting Chutes

By C. R. ANDREW
Junior Engineer, U. S. Engineer Office, Ohio River Dam No. 16

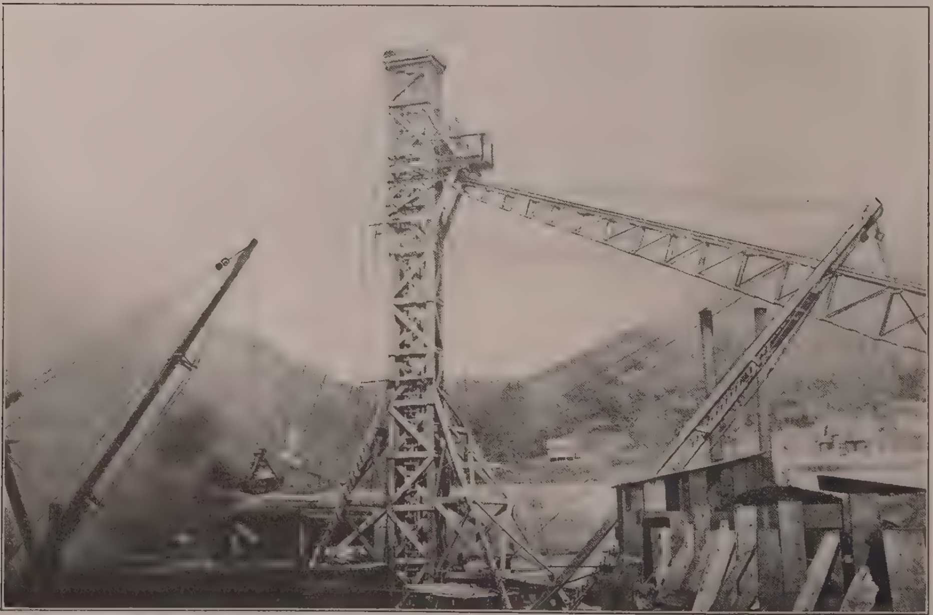
THE MIXER boat shown in the accompanying photographs was used to great advantage in constructing lock and dam No. 16 on the Ohio River near Bens Run, W. Va. The essential new features of the boat, as may be seen from the illustrations, are the 80-ft. wooden A-frame and the 156-ft. steel boom to support the chutes, which arrangement allowed the boat to be set in place ready to concrete with little rigging and in a short time. The boat carried a mixer, receiving bins and a 96-ft. wooden tower. Sand and gravel were placed in the receiving bins by a derrick boat. From the bins the aggregate ran by gravity into measuring hoppers and thence into the 1-yd. mixer placed at the base of the tower. The mixed concrete was hoisted to the top of the tower by a mine hoist using a single line, dumped into a receiving hopper and spouted into the forms.

The departure from common practice in using the A-frame and steel-boom arrangement for supporting the chutes greatly facilitated moving from one form to another. During the early part of the season the mixer boat was used without the boom, the chutes being supported from a cable running over the top of the tower and attached to a deadman on the bank or on the cofferdam. To move and hang chutes in this way costs about $50.00 per move and required from three to four hours time. After installing the boom, moves were made in from 45 min. to 2 hr., depending upon the amount of chute required to reach the form from the end of the boom, and the cost of the moves was cut in even greater proportion.

Another advantage of the boom over the cable is that the concrete will flow on a much flatter slope. Using the cable it was found that the chutes must be hung on a slope of not less than 3 on 1, and even this slope often gave trouble on account of clogging and overflowing. Using the boom it was found that the concrete would flow freely with a 1 on 4 slope, and if necessary even on a less slope. It is believed that this is due to the rigid support given the chutes by the boom. During the period from Sept. 16 to Oct. 15 this boat placed 14,660 batches of concrete, no work being done on Sundays or holidays.

The contract for lock and dam No. 16 was signed on Aug. 6, 1913, with a specified time limit of four years. At present practically all the permanent work is complete and there only remains cleaning up and removal of cofferdam and plant. The total amount of the contract is about $970,000.

This work is being done by the T. A. Gillespie Company of New York and Pittsburgh, under the direction of the Corps of Engineers, U. S. A., Major T. H. Jackson, district officer. N. J. Beisel is superintendent for the contractor, and the writer is assistant in charge for the Government. The mixer boat was designed by H. B. Mish, engineer for the contractor, under the direction of T. S. Shepperd, vice-president, and was built by the contractor's forces at the site.



GUYS AND BRACES OF 96-FT. TOWER ALLOW FREE OPERATION OF DERRICK BOAT

Acid Water Decomposes Dynamite Charges with Serious Results

THE MOST serious blasting accident in building the Panama Canal, which killed twenty-three men and injured forty others near Bas Obispo, was finally traced to decomposition by acid water of the 22 tons of 45-per cent dynamite loaded in the 52 holes which exploded prematurely, according to a statement by Maj.-Gen. George W. Goethals, in a paper presented last month to the International Engineering Congress.

The charges had been tamped and the fuses set in all. The last hole was being loaded at the time of the accident. The entire charge was to be set off by electric current from the Empire power plant after 5 o'clock on the day of the accident. The wires were not strung and the fuses of no two of the holes were joined. Furthermore the dynamos at Empire were not in service at the time the explosion occurred. It was a clear day and there was no lightning to which the explosion could be ascribed. It developed later, when the water in the bottom of the holes was examined chemically, that the water was acid and that it would attack the cartridges, liberating the nitroglycerin. It was known that a "dobe" blast had been fired just across the cut from where the explosion occurred, and it was assumed that the accident was due to the detonation of a quantity of free nitroglycerin by the jar of the "dobe" blast. Further investigation showed that the action due to the acidity of the water required approximately 24 hours for the release of the nitroglycerin, and the holes had been loading for several days. As a consequence, no loading operations were undertaken thereafter in any area that could not be completed and fired on the same day.

MUD REMOVED FROM ST. LOUIS WATER in 1915 amounted to 358,000 tons. To accomplish it required 13,660 tons of lime and 6770 tons of sulphate of iron. The sterilization process utilized 28 tons of liquid chlorine.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Preparations for Hetch Hetchy Work Being Rushed to Completion

Before the snows of the coming winter render difficult work in the Hetch Hetchy Valley, the contract for clearing timber and brush from the 808-acre reservoir area, which is to be used for storing the new San Francisco water supply, will be nearing completion.

The city engineer's force is working overtime in the preparation of specifications for 67 miles of railroad between Rosasco and the dam site. Every effort is to be made to rush the completion of this line, which is expected to afford a great saving in transportation costs. Delivery of material at the dam site by teams and motors is now costing $24 per ton, which is to be reduced, it is expected, to $9 per ton when the railroad is in operation. On the 300,000 tons of freight to be transported this will be a saving of $4,500,000. The estimated cost of the road will be about $1,700,000.

A diversion tunnel 500 ft. long and 20 ft. in diameter has been started through which the Tuolumne River will be carried past the site of the main concrete dam. This tunnel is now one-tenth completed and will make it possible to unwater the dam foundations which are now submerged to a depth of 20 ft. The tunnel is being driven from two headings, each of which is being advanced at the rate of 2½ ft. per day. It is expected that this tunnel will be completed by the end of 1915 and that the diversion dam under simultaneous construction will be completed about March 1, 1916.

Four miles from the site of the Hetch Hetchy dam a sawmill has been erected, which is now turning out lumber at the rate of about 18,000 ft. b.m. per day at a cost of $8 per thousand.

Longest Stretch of Concrete Road in Illinois Dedicated

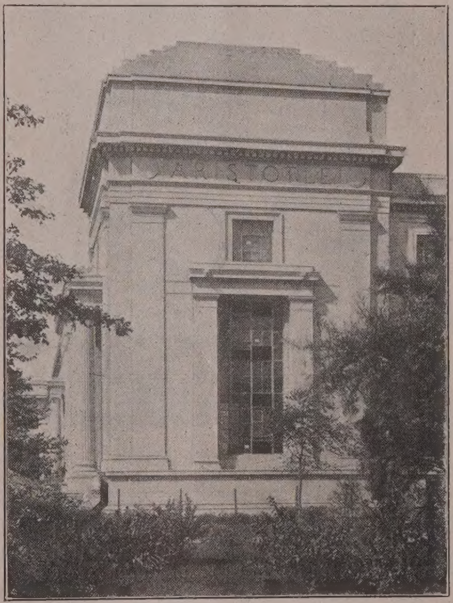
The new State-aid concrete pavement on Milwaukee Avenue, Cook County, Illinois, declared by one of the speakers to be the longest stretch of concrete road in the State, was formally dedicated Oct. 16.

Milwaukee Avenue is one of the most important thoroughfares in Illinois. It is the artery of a large system of county roads and an outlet from the extensive truck gardening district tributary to Chicago. When several of the contemplated pavements from Evanston, Wilmette and other North Shore suburbs of Chicago are completed, and when the concrete section on Milwaukee Avenue has been extended to the county line, as is now planned, there will be a direct good roads route from Chicago and the North Shore suburbs to the attractive lake region of Northern Illinois and Southern Wisconsin.

Sixth Concrete Crib for Victoria Harbor Under Construction

The sixth concrete crib used in the construction of the piers in the Victoria harbor improvement scheme is now under construction and will be launched from the marine ways in the near future. Since the first two cribs were constructed on a floating drydock marine ways were built to accommodate four cribs simultaneously and three have been successfully launched by the new method.

Since the commencement of the work the following items have been completed: Earth excavation, 31,940 cu. yd.; rock excavation, 20,183 cu. yd.; rubble foundation, 365,699 tons.



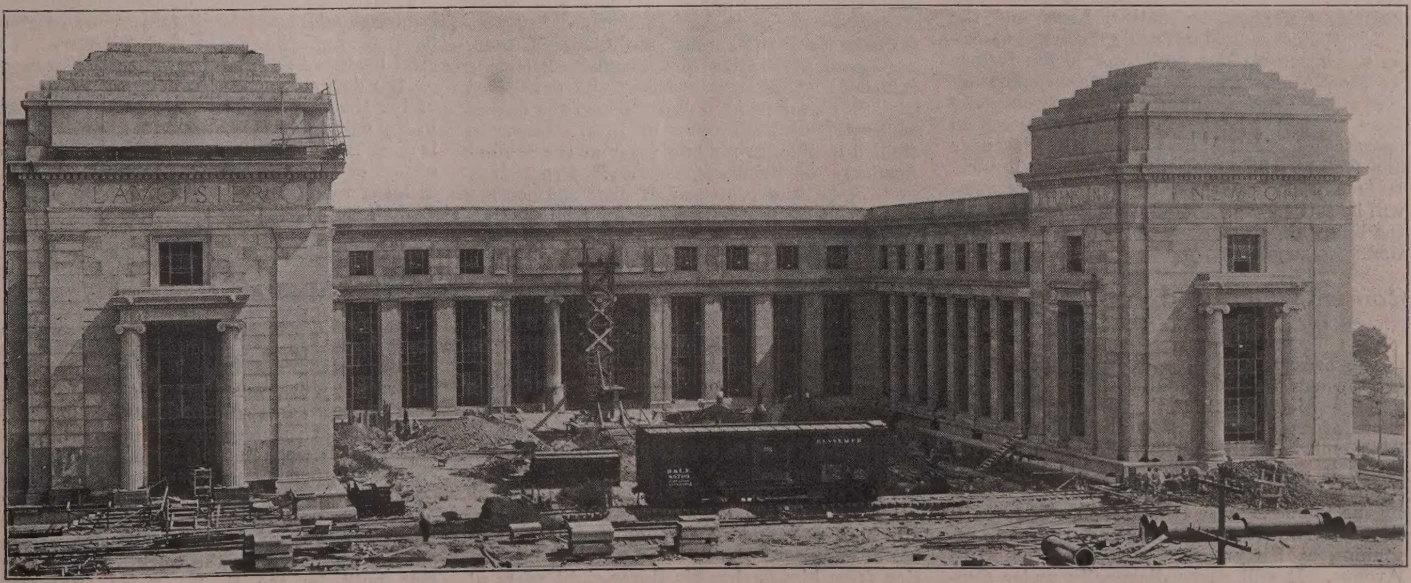
FIRST FINISHED TOWER OF NEW TECHNOLOGY BUILDINGS IN CAMBRIDGE

Coroner's Jury Would Keep Traffic Away from Subway Blasts

The coroner's jury investigating the subway accident which occurred on Seventh Avenue, in New York City, on Sept. 22, returned a verdict on Oct. 26 in which it was recommended "that at the time of blasting in the subways of greater New York no traffic of any kind be allowed over any part of the temporary structure."

The verdict concludes that the deaths which occurred were "due primarily to an excessive blast at the northeast heading of the excavation. That while due care was not exercised in estimating the amount of explosive to be used in this particular blast, the evidence submitted does not show criminal negligence." It was further recommended that "the Public Service Commission shall designate the maximum to which temporary work shall precede the permanent structure. The jury, in deploring this accident, expresses the hope that it will serve to impress on all contractors and the Public Service Commission the necessity for the utmost caution and care, both in operation and inspection of all subway work."

The jury also censured the Bureau of Combustibles of the Fire Department, which has control of all blasting operations, for not carrying out through its inspectors the powers assigned to it by the code of ordinances. The jury failed to state in its findings just what ordinances the Bureau of Combustibles was blamed for not carrying out. From the testimony at the inquest, however, J. O. Hammitt, head of the Fire Prevention Bureau, is reported to have considered that the jury referred to the use of blasting mats made of timber and rope to cover the blast and prevent fragments of rock from flying. Mr. Hammitt is further quoted in the press as saying that such a covering of the blast would have introduced a very serious hazard by providing missiles in the form of logs used in the covering, which would have been a great danger to the timbering. He is also quoted as saying that there was no evidence of any of the holes having been overloaded and that whether there were too many holes, whether they were improperly located or whether there was too heavy a charge in any one of them were matters over which the fire department had no control. The verdict cleared the contractors and the Public Service Commission of the charge of criminal negligence.



MAIN BUILDINGS FOR NEW TECHNOLOGY WILL SOON BE READY FOR OCCUPANCY BY ENGINEERING STUDENTS

Dr. Corthell Nominated for Presidency of Am. Soc. C. E.

Dr. Elmer L. Corthell, consulting engineer of New York City, has been nominated for the presidency of the American Society of Civil Engineers. The other candidates for offices to be filled at the annual meeting to be held Jan. 19, 1916, are: For vice-presidents, Palmer C. Ricketts, of Troy, N. Y., and Alfred Craven, of New York; for treasurer, Lincoln Bush, of New York; for directors, Virgil G. Bogue and Alexander C. Humphreys, both of New York, district 1; Otis F. Clapp, of Providence, R. I., district 2; Richard Khuen, of Pittsburgh, district 4; F. G. Jonah, of St. Louis, district 5; Edwin Duryea, Jr., of San Francisco, district 7.

Illinois Waterworks Officials Meet in Chicago

Seventy-five waterworks officials, engineers, superintendents and their friends met in Chicago, Oct. 19, at the annual fall meeting of the Illinois section of the American Waterworks Association. John Ericson and his assistants piloted the visitors over the route of the new Wilson Avenue tunnel, the municipal pier, which is nearing completion, and the municipal shops. He talked about the tunnel and the new type of intake in the evening (see Engineering Record, Jan. 16 and 23, pages 73 and 103). S. A. Greeley also delivered an illustrated paper on "Water Softening for Municipalities."

An invitation from the American Association of Engineers to name a committee to cooperate with the new association was accepted, after it was explained that the Jovians, an order represented by 26,000 electrical men, had also named such a committee.

Start Work on $2,000,000 Power Project in Wisconsin

Work was started by the Wisconsin-Minnesota Light & Power Company, Oct. 20, on the construction of the power dam on the Chippewa River, two miles east of Chippewa Falls, Wis., at what is known as the Paint Creek site. The dam, which will be over three-fourths of a mile long and sixty feet high will generate about 50,000 hp. The entire work, including the cost of the flowage rights, the closing of several highways and bridge erection, will bring the construction cost to about $2,000,000 and, it is expected, will take about two years to complete.

Rock Island Proposes to Lease Track to Gas-Electric Line

Negotiations are now in progress between the recently organized Muscatine-Iowa City Railway Company, Muscatine, Iowa, and the Chicago, Rock Island & Pacific Railway, whereby the latter railway will lease to the former its Montezuma branch, a line approximately 100 miles long, running through twenty-two Iowa towns. The new company proposes to operate gas-electric cars for both passenger and freight traffic over the Montezuma branch. It is expected that details of the agreement will be settled shortly, and that by Jan. 1, 1916, the line will be taken over by the new corporation.

Consents Obtained for Queensboro Tunnel, New York City

The necessary number of consents of property owners has been obtained to legalize Route 61, the so-called Sixtieth Street-East River route of the New York dual transit system. This embraces the tunnel under East River which it has been decided to build instead of using the Queensboro Bridge, as first proposed by the Public Service Commission. The line is to be a two-track underground railroad, beginning at Fifty-ninth Street, west of Fifth Avenue. It will curve diagonally under Central Park and Fifth Avenue into Sixtieth Street, and run along Sixtieth Street to and under the East River to North Jane Street, Long Island City, where it will emerge from the ground and connect with the new elevated lines in Queens Borough.

Yale Professor Who Died Last Week Was Noted Structural Authority

Augustus Jay DuBois, whose death on Oct. 19 was noted in this journal last week, was the author of some of the best known treatises on mechanics and stresses in the English language. His "Strains in Framed Structures," first published in 1883, has long been a standard engineering work, and is now in its eleventh edition. His book on "Graphic Statics," published in 1876, was largely instrumental in introducing to American engineers the graphic method now so widely used for determining stresses in framed structures. He translated and edited several important German works on mechanics, including Weisbach's "Mechanics of Engineering." A series of books on mechanics culminated in his "Mechanics of Engineering," published in 1901. In addition, Professor DuBois contributed numerous articles to technical journals and many essays to current periodicals.

Noted Authority on Structural Design Who Recently Died at New Haven

AUGUSTUS JAY DUBOIS

Professor DuBois was born April 25, 1849, was graduated from the Sheffield Scientific School in 1869, was awarded the degree of Civil Engineer in 1870 and received the degree of Doctor of Philosophy in 1873. Later he studied mechanics for two years at the Mining Academy in Freiburg, Saxony. From 1875 to 1877 he was professor of civil engineering and mechanical engineering at Lehigh University. In 1877 he was appointed professor of mechanical engineering in the Sheffield Scientific School, from which chair he was transferred to that of civil engineering in 1884. He remained in the school both as a member of its faculty and as a member of its governing board until his death. He was also for many years one of the representatives of the Scientific School on the University Council. In 1883 Professor DuBois was married to Adeline Blakeslee of New Haven, who survives him.

Professor DuBois' direct influence on the profession of civil engineering is well known. His indirect influence, through the large number of engineers who received personal instruction from him during his thirty-eight years at the university, is probably much greater.

Good Roads Campaign Being Organized in the Argentine

Realizing the importance of a system of good roads for bringing products to the railways, a strong effort is being made in the Argentine Republic to organize a good roads compaign. According to *The Americas*, published by the City National Bank of New York, the National Congress now has before it a project of law for the reorganization of the Federal bureau of good roads into a Federal commission on bridges and roads, which shall take up the whole subject comprehensively, employ engineers and make surveys, prepare a plan for interior communications with existing and projected railways, unify the efforts of minor governing bodies and hold conferences of officials, publicists and organizations interested in good roads to discuss roadway problems.

Ask Bids for Jersey City Pipe Line

Jersey City has advertised for bids on the eleven-mile 72-in. pipe line that has been under discussion for several years. The work will include a single line of steel pipe of the diameter already stated and a double line of 48-in. cast-iron pipe under the Passaic River.

New Mannheimer Building in St. Paul to Be Abandoned

The steel skeleton of the Mannheimer Building in St. Paul, Minn., is to be dismantled and removed. Owing to financial reasons the project for a large seven-story department store on this site is to be abandoned, although the steel frame had been completely erected about a year ago. Special features of this building and the design were described in the Engineering Record of Aug. 7, page 159, and of Sept. 25, page 392.

Illinois Utility Commission Suggests Chicago Dig Subways

The Chicago Surface Lines were ordered on Sept. 30 by the State Public Utility Commission to better their service within 60 days. Rerouting to increase track capacity and the use of trailers were the main points. In an opinion accompanying the formal order was the recommendation that subways be constructed, that the surface and elevated lines be consolidated, that the city prohibit the use of car tracks by vehicles during rush hours, and that additional bridges over and tunnels under the river be built.

Illinois Highway Department Makes Offer of Shop Inspection

The Illinois Highway Department in a circular letter addressed to all fabricators of structural steel offers to make shop inspection of all steel bridges the plans for which are prepared by the department, as covered by Section 348 of the General Specifications for Bridge Work in the edition of July, 1915. William W. Marr is chief State highway engineer. A notification of two or three days before the structural material is ready for inspection, to be sent to the department, is requested.

Massachusetts Reservoir Finished Six Months Ahead of Time

The Ashby reservoir for the city of Fitchburg, Mass., is now practically completed, six months in advance of the time specified in the contract. Work was started April 15 of this year, since when two dams, 1200 ft. long, each consisting of concrete core walls, spillway and rolled earth embankment, with other work incidental to flooding a reservoir basin of 700,000,000 gal. capacity, have been finished. Ernest E. Lothrop is city engineer of Fitchburg, and Metcalf & Eddy of Boston are consulting engineers for the work. The reservoir was built by the E. W. Foley Contracting Corporation of New York City.

News of Engineering Societies

The Public Utilities Association of West Virginia will hold a convention at White Sulphur Springs, W. Va., Nov. 18 and 19. This association is composed of electric railways, electric light and power companies, and water and telephone companies. W. C. Davisson of Charleston, W. Va., is secretary.

The Western Society of Engineers will hold a meeting Nov. 2, at which time L. E. Johnson, president of the Norfolk & Western Railway, will speak on "The Relations Between the Railroads and the Public." The discussion will embrace the railway situation, with especial reference to regulation as it is and as it ought to be.

Personal Notes

NICHOLAS S. HILL, JR., consulting engineer of New York City, has been awarded the 1914 prize of the Municipal Engineers of the City of New York for his paper, "Valuation of Public Utilities."

ALFRED D. FLINN, deputy chief engineer of the Board of Water Supply, has been delegated to represent the Municipal Engineers of the City of New York at the Pan-American Scientific Congress to be held in Washington, D. C., Dec. 27 to Jan. 8.

DON L. TEAL, formerly assistant county engineer of Jefferson County, Iowa, has been appointed county engineer of Lucas County, Iowa, succeeding Leo Hollingshead, resigned.

EDWARD H. SARGENT, formerly assistant civil engineer on the forces of the New York State Conservation Commission, has been appointed assistant engineer of water power, storage and drainage, by George D. Pratt, State conservation commissioner, at an annual salary of $3,000. Mr. Sargent was selected from the Civil Service list resulting from a recent examination for the position, his name being second on the list. He was graduated from the Massachusetts Institute of Technology in 1907, and, for six months thereafter, served as rodman for the Board of Water Supply of New York City on surveys, designs and estimates of structures on the Catskill Aqueduct. He was appointed instrumentman and draftsman on the forces of the State water supply commission in 1907 and attained the grade of assistant civil engineer in 1910. In connection with this work he made rainfall and stream flow studies and preliminary designs and estimates for water power and water supply projects. When the water supply commission was consolidated with the State Conservation Commission he retained his position and continued in it up to the present appointment.

RAY E. KOON of the firm of J. B. & R. E. Koon, civil, hydraulic and sanitary engineers, of Portland, Ore., will have charge of the surveys for the Sultan River water supply for the city of Everett, Wash., representing Burns & McDonnell, consulting engineers, of Kansas City. The citizens of Everett recently voted a bond issue of $600,000 for the Sultan River work.

E. SHELAH, formerly engineer maintenance-of-way of the Decatur division of the Wabash Railroad, has been appointed engineer maintenance-of-way of the Springfield division, with headquarters at Springfield, Ill.

G. P. MACLAREN has been appointed division engineer of the Toronto district of the Canadian Northern Railway, with headquarters at Rosedale, Toronto, Ontario.

ROBIN A. BOWMAN, formerly engineer and contractor for the Maceio Electric Tramways, Maceio, Brazil, has been appointed engineer in charge of maintenance and construction on railroad work for Bartram Brothers at San Pedro de Macoris, Republic of Santo Domingo.

F. C. FRENCH, formerly designing engineer for the Anaconda Copper Mining Company, whose return to Salt Lake City, where he intended to open offices for the purpose of resuming consulting practice, was noted in these columns, Oct. 9, has been engaged as construction engineer on the remodeling and enlargement of the plant of the Beatson Copper Company at Latouche, Alaska.

A. J. GAYFER has been appointed division engineer of the Lake Superior district of the Canadian Northern Railway, with office at Capreol, Ontario.

WILLIAM C. HATTAN, formerly division engineer on the Carolina, Clinchfield & Ohio Railroad, at Dante, Va., is now engaged in preparing plans for a water system and street improvements for the town of Kingsport, Tenn. Mr. Hattan was graduated from Washington & Lee University in 1899 and entered railway service as rodman on the West Virginia Shore Line Railroad in July of that year. He left the road in 1901 and served for a few months as masonry inspector on the Western New York & Pennsylvania and, later, as chief of party for James H. Nichols, civil and mining engineer, of Sharon, Pa. In 1902 he was appointed resident engineer on the Ozark & Cherokee Central, in charge of work in the Indian Territory. From 1903 to 1904, he was assistant engineer for Vandevanter & Hood, civil engineers, of Baltimore, in charge of the location and construction of the Baltimore and Belair Electric Railway. In 1904 he was appointed resident engineer of the Cumberland extension of the Western Maryland at Hancock, Md. He left that work in 1905 to accept a similar appointment on the Potomac Valley. Later he was resident engineer on the South & Western. He was appointed division engineer on the Carolina, Clinchfield & Ohio, in which capacity he had charge of the construction of that company's Elkhorn extension, in 1913.

J. D. EVANS, formerly division engineer for the Canadian Northern Railway at Trenton, Ontario, has been appointed supervisor of bridges and buildings.

W. V. CRUSE, formerly resident engineer on the forces of the Illinois State Highway Department, has joined the staff of Edwards & Chamberlain, consulting engineers, of Eldora, Iowa.

MARSHALL K. WHITE has resigned from the engineering department of the Spring Valley Water Company, San Francisco, to become assistant city engineer of Jackson, Tenn.

J. V. SNYDER has been appointed engineer of location and construction on 10 miles of railway extension for the Meadow River Lumber Company at Rainelle, W. Va.

CHESTER B. LEWIS, superintendent for Albert Kahn, architect, of Detroit, has changed his address from Ann Arbor, Mich., where he was in charge of the construction of the Science Building for the University of Michigan, to St. Louis, where he will have charge of the construction of an addition to the assembling plant and service station of the Ford Motor Company.

PERCIVAL H. EVERETT has resigned from the office of chief engineer for the Kern County (Cal.) Highway Commission. He was appointed to the office in 1913, after having served for two years as assistant chief engineer of the Los Angeles County Highway Commission.

J. H. SHEDD, consulting engineer, of Providence, R. I., has been appointed consulting engineer for the water department of East Hartford, Conn., to act with C. H. Olmsted, city engineer, in the matter of increasing that city's water supply.

THOMAS L. HINES, JR., has resigned from the engineering forces of the Baltimore paving commission to accept an appointment as efficiency engineer for E. I. du Pont de Nemours & Company, manufacturer of explosives, of Wilmington, Del.

W. G. KIEKHOFFER has been appointed consulting engineer for the department of the State engineer of Wisconsin.

EDMUND PENNINGTON was re-elected president of the Wisconsin Central Railway at a meeting of the board of directors, held at Minneapolis, Oct. 18.

WILLIAM F. PERKINS has resigned from the engineering forces of the Paving Commission of Baltimore to accept a position with the Bartlett-Hayward Company, engineers, of New York City.

L. M. ROTH has resigned as engineering salesman for the Illinois Steel Company and the Carnegie Steel Company at St. Paul to open offices in the Security Bank Building, Minneapolis, for the purpose of engaging in business as dealer and broker in engineering specialties. Mr. Roth is a graduate of the University of Minnesota in civil engineering.

C. W. FINDLEY has been appointed levee district engineer of Ellis County Levee District No. 2 by Capt. A. A. Stiles, State reclamation engineer of Texas.

FREDERIC W. DARLINGTON has become associated with J. B. Berry, S. S. Roberts and A. G. Shaver for the purpose of engaging in practice as consulting engineer, with offices in the Transportation Building, Chicago, Ill., and in Los Angeles, Cal.

G. M. HARBERT has been appointed county road engineer of Harrison County, W. Va., with headquarters at Clarksburg.

R. R. MARSDEN has severed his connection with H. S. Ferguson, consulting engineer of New York City, by whom he has been employed for the past five years, to join the engineering department of the Laurentide Company, Ltd., at Grand Mère, Province of Quebec, Canada.

Obituary Notes

H. M. MCCARTNEY, who was identified with early construction on the Union Pacific Railroad and the San Pedro, Los Angeles & Salt Lake Railroad, and later became assistant engineer of the Western Pacific Railroad at San Francisco, died recently in Los Angeles at the age of sixty-seven years. Mr. McCartney retired from active railroad life about four years ago, since which time he has been connected with the land department of the Southern Pacific Railroad in Los Angeles.

OLAF R. PIHL of the firm of Pihl & Miller, contracting engineers, of Pittsburgh, died in that city, Oct. 14. He was born in Norway and came to this country in 1880. About fifteen years ago he served for a period in the U. S. Engineer's Office and later was constructing and supervising engineer with the Pan-American Exposition. He was also associated at one time with the Dravo Contracting Company.

Civil Service Examinations

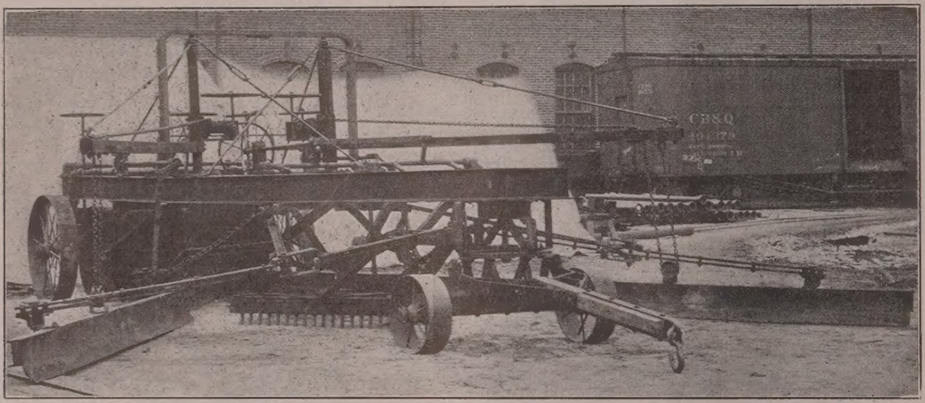
Examinations Previously Announced

Date		See Eng. Record
Nov. 6	Chief sanitary engineer, sanitary engineering bureau, Board of Health, Illinois	Oct. 9
Nov. 10	Assistant sanitary engineer, Board of Health, New Jersey	Oct. 16
Nov. 13	Civil engineer, Grade 4, highway department, California	Oct. 16
Nov. 20	Engineering draftsman, Grade 2, California	Oct. 16
Dec. 4	Mechanical engineering draftsman, California	Oct. 16
Dec. 6	Sanitary engineer, Massachusetts	Oct. 16
Dec. 8-9	Surveyors and transitmen; General Land Office, United States	Oct. 16

Combine Road Scarifier, Planer, and Roller in One Machine

A machine which combines the properties of a road scarifier, a planer and a roller has been placed on the market. It is designed to re-surface in one trip over a road its entire roadway from ditch to ditch, and leave a uniformly crowned grade with a rolled, compact and well finished center.

The main frame of the machine is made of 10-in. I-beams of heavy section braced and tied together. Each scraper bar or blade is made up in three sections, and is fitted with a detachable cutting edge, in the same manner as the ordinary road machine blade. The roller frame is made of structural steel and the rollers, which are 42 in. in diameter, are carried on a 3-in. steel axle. The rear axle of the machine and the roller axle are set in parallel, longitudinal positions, in order to avoid bending of the rolls when making short turns. The toggle principle is employed for opening and closing the blades and also for holding them at their various working angles. The front center and rear of each blade can be raised or depressed independently. The extreme width of cut that can be made is 30 ft., but it can be decreased to 15 ft. by the turning of two hand wheels. The blades when folded for transportation rest on supports located above the front wheels of the machine so that there is nothing to prevent short turning. The weight of the rear end of the machine can be transferred to the face of the rolls as the machine passes along, thus increasing the roller pressure at will. The machine, which requires between 25 and 40 hp. to operate, is manufactured by the Western Wheeled Scraper Company, Chicago.



MACHINE SCARIFIES, PLANES AND ROLLS ROAD IN ONE OPERATION

Condron Company Issues Bulletin on Flat Slab Patents

The recent court decision sustaining the Norcross patent for flat-slab floor construction and the general interest in this subject led the Condron Company to discuss in detail the different systems in their September bulletin, with the title "Regarding Flat Slab Patents and the Akme System." Photographs and drawings clearly illustrate the difference between the various systems, and of the Norcross and of the Sinks patents histories are given, together with a copy of the latter, in full. Copies of the bulletin will be sent free, on request, by the Condron Company, 1215 Monadnock Building, Chicago.

Standards Set by Testing Material Society Adopted by Brick Men

Paving brick specifications recently adopted by the American Society for Testing Materials by letter ballot were accepted as standard by the National Paving Brick Manufacturers' Association at Dayton, Ohio, Oct. 12. The association urged the American Society of Municipal Improvements also to change their specifications to conform, but the effort was not successful.

It was announced that work started by J. E. Howard of the Bureau of Standards on brick road tests will be resumed this fall in Cleveland and other cities.

The following officers were elected for the ensuing year: President, C. C. Blair; vice-president, J. W. Robb; treasurer, C. C. Barr; secretary, Will P. Blair, Cleveland, and H. H. Macdonald, assistant secretary

Rules Issued to Help Prevent Winter Concrete Failures

The following condensed statement of the precautions to be observed in placing concrete in freezing winter weather now approaching is taken from a printed circular headed in red ink "Caution" and circulated by the Trussed Concrete Steel Company of Youngstown, Ohio, to be used by superintendents and foremen on concrete and form work and posted in conspicuous places on the work.

1. During cool weather, even though not freezing, the setting of cement is delayed. The only sure way of knowing when the cement is fully set and the concrete properly handled is to actually test it with a hammer for hardness.

2. Be careful to avoid freezing of the concrete. Protect all freshly-laid concrete by covering it with some material that will prevent freezing. Be especially careful to protect this concrete during the night. If absolutely necessary to place concrete during freezing weather, the materials should be heated and the placing of the concrete so protected as to keep the temperature above freezing.

3. Workmen are apt to become careless during cold weather. Therefore, the superintendent in charge should take particular care to see that the forms are properly braced, that the bottoms of beam and column boxes are clean, that the steel is accurately placed, and the concrete thoroughly mixed. Special vigilance is required at this season of the year.

4. The most important point, one whose importance cannot be overestimated, is caution in the removal of the form work. Forms must not be removed until absolutely certain that the concrete is thoroughly hardened and that no portion is either soft or frozen. Remove forms carefully and without shock to the structure and always leave in place a few posts to avoid placing the entire dead weight too suddenly on beams and columns.

To Have Alternate Periods of Quiet at Cement Show

In accordance with the wishes of the majority of exhibitors, each alternate half hour at the Cement Show, to be held in Chicago in February, 1916, will be a period of quiet. Beginning every hour, machinery will be permitted to run for thirty minutes. Periods of quiet will follow in the second half. The beginning and end of each period will be announced by the sounding of gongs.

Mixer Manufacturers Association Adopt Standard Rating Method

A resolution providing for the uniform rating of concrete mixers was adopted at the August meeting of the National Association of Mixer Manufacturers. Up to the present time there has not been a standard method for such rating. Some manufacturers give capacities in mixed concrete, while others give them in loose material. According to the resolution adopted, the capacity of a mixer will be specified according to the "size of wet, mixed batch." The dry capacity may be approximated as one and one-half times the wet mixed batch, assuming the use of cement, sand and 1½-in. stone, with 1¾ gal. of water per cubic foot.

Another Pamphlet Out on Trade Activities of European Nations

Swiss commerce is the subject of the latest booklet of the Bureau of Foreign and Domestic Commerce, Department of Commerce, on the home trade campaigns and organizations of the leading European nations. It is entitled "Commercial Organizations in Switzerland." The economic history of trade organizations in Switzerland and the types evolved are included in the text, besides a discussion of the Swiss Federal Department of Commerce and general information concerning industrial localizations, principal products and commercial publications of the country. The publication can be had by sending five cents to the Superintendent of Documents, Washington, D. C., asking for booklet 101 of the Special Agents series.

Business Notes

The Garford Motor Truck Company of Lima, Ohio, has opened a branch office at Twenty-third Street and Indiana Avenue, Chicago, to handle its sales and service business, which was formerly handled by the Overland Motor Company. C. A. Crane will have charge of the new office, assisted by C. E. Golder, Fred Liser and J. C. Philpott.

The Detroit Steel Products Company of Detroit attained the largest monthly output in its history in September. Previous high monthly records have been made in the spring and early summer.

Industrial Works, manufacturer of locomotive cranes, pile drivers, grab buckets and similar equipment, of Bay City, Mich., has established a branch office in the Widener Building, Philadelphia.

Trade Publications

The following companies have recently issued trade literature:

Magor Car Company, 30 Church Street, New York. General catalog G, 11 x 8½ in., 64 pages, illustrated. Railroad cars, box, gondola, hopper, tank, flat, cane and logging types. Catalog written in English and Spanish, one the translation of the other.

American Bitumastic Enamels Company, New York City. "Recent Achievements in the Prevention of Corrosion." Paper, 8 x 10 in., 47 pages, illustrated. This booklet is unusually well written and illustrated and covers many of the various fields of application of protective points to the protection of steel structures. After discussing the electrolytic theory of corrosion and a short early history of the bitumastic products, a detailed description is given of their use on the Panama Canal lock gates, on marine work, on drydocks and on pontoons, on the Catskill aqueduct, the Narrows siphon and other waterworks systems, on standpipes and water tanks, on sewage plants, and on other structural work. Comparative costs are stated, and reports of scientific tests are detailed. Directions for applying and specifications for steamers are also included.